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ELECTRONIC PERFORMANCE OF THE

S-52 FLIGHT 1 SPACECRAFT

UNDER THERMAL-VACUUM EXPOSURE

I-320-64-156

OCTOBER 26, 1964

Limited to NASA only

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OCTOBER 26, 1964

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Electronic Performance
of S-52 Flight 1 Spacecraft
Under Thermal-Vacuum Exposure

by

Nathan Mandell

and

Harry W. Leverone

Summary 29410

A summary of the electronic performance of the UK-2/S-52 flight 1 spacecraft throughout the thermal-vacuum exposure is included in this report.

The data collected, calibrations performed, and analyses made, to evaluate the performance of the spacecraft throughout the exposure are included in the appropriate sections of this report. Test procedures and instrumentation are also covered.

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CONTENTS (continued)

ILLUSTRATIONS

ILLUSTRATIONS (continued)

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TABLES (continued)

ABBREVIATIONS

Amp.	-	amplifier
Batt.	-	battery
BB	-	broadband
CAL	-	calibrate
cm	-	centimeter
Chan	-	channel
Chg	-	charge
I	-	current
DROD	-	delayed readout detector
DC	-	direct current
Dischrg	-	discharge
R_1	-	dumping resistor on solar paddle arm R_2
R_2	-	dumping resistor on solar paddle arm R_4
$\overline{T}$	-	encoder clock frequency
EHT	-	extra high tension
EXT	-	external
FAP	-	foil advance pulse
GN	-	galactic noise
gnd	-	ground
GS	-	ground station
HL	-	hardline
HP	-	Hewlett Packard

ABBREVIATIONS (continued)

HS	-	high speed
$\bar{L}$	-	high-speed matrix A output
$\bar{A}$	-	high-speed reset
HT	-	high tension
IROD	-	instantaneous readout detector
LS	-	low speed
Mag	-	magnetic
Mech	-	mechanism
Mc	-	megacycle
MM	-	micrometeorite
μsec	-	microseconds
ms	-	milliseconds
M1	-	mode 1
M2	-	mode 2
Mod	-	modulation
Mon (O_2)	-	monitor amplifier
Neg	-	negative
Osc	-	oscillator
Oz (O_1)	-	ozone
O_1	-	ozone amplifier
PMA	-	ozone spectrometer amplifier A
PMB	-	ozone spectrometer amplifier B
PP	-	performance parameter
PA	-	period average

ABBREVIATIONS (continued)

Ø	-	phase
PB	-	playback
P-2	-	Programmer 2
Proto	-	prototype
Sig	-	signal
S/C	-	spacecraft
Spect	-	spectrometer
O_3	-	spectrometer outputs
SU	-	speedup
Stab	-	stabilizer
SR	-	sunrise
SS	-	sunset
Swp	-	sweep
SW	-	switch
Sync	-	synchronization
TR	-	tape recorder
TM	-	telemetry
temp	-	temperature
T.V.	-	thermal vacuum
XMTR	-	transmitter
UV	-	undervoltage
Unreg.	-	unregulated
Vert	-	vertical
E	-	voltage

ABBREVIATIONS (continued)

v	-	volts
VAC	-	volts alternating current
WB	-	wideband

1. INTRODUCTION

The S-52 flight 1 spacecraft was subjected to the flight acceptance thermal-vacuum exposure from August 22 to September 5, 1963. Figure 1-1 is a complete time history of exposures, pertinent events, and plots of the spacecraft telemetry-temperature performance parameters.

The S-52 flight 1 spacecraft performed as intended, except for anomalies shown in Table 1-1. Modifications of the spacecraft to correct these anomalies were verified in the subsequent preflight exposures.

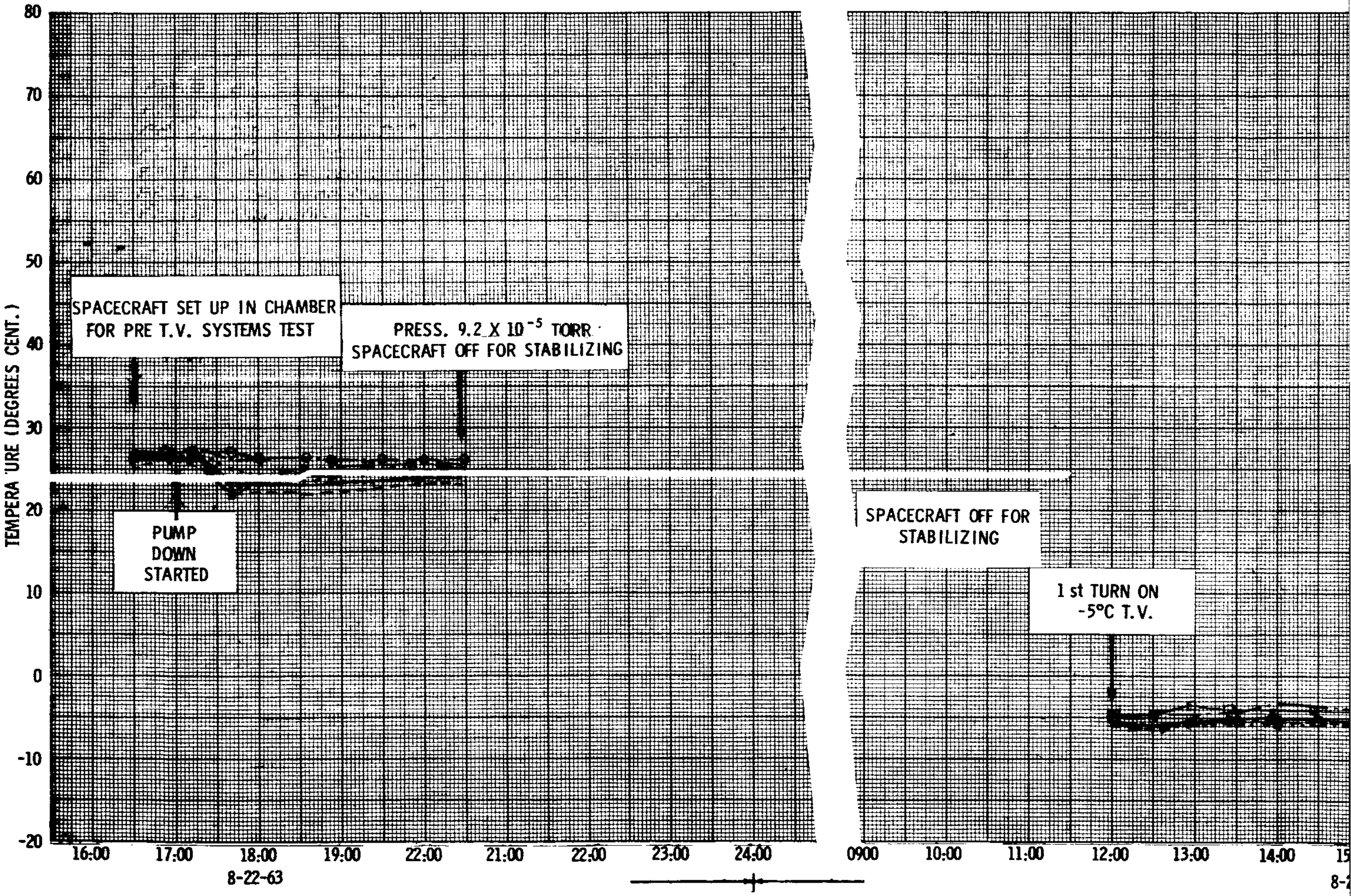
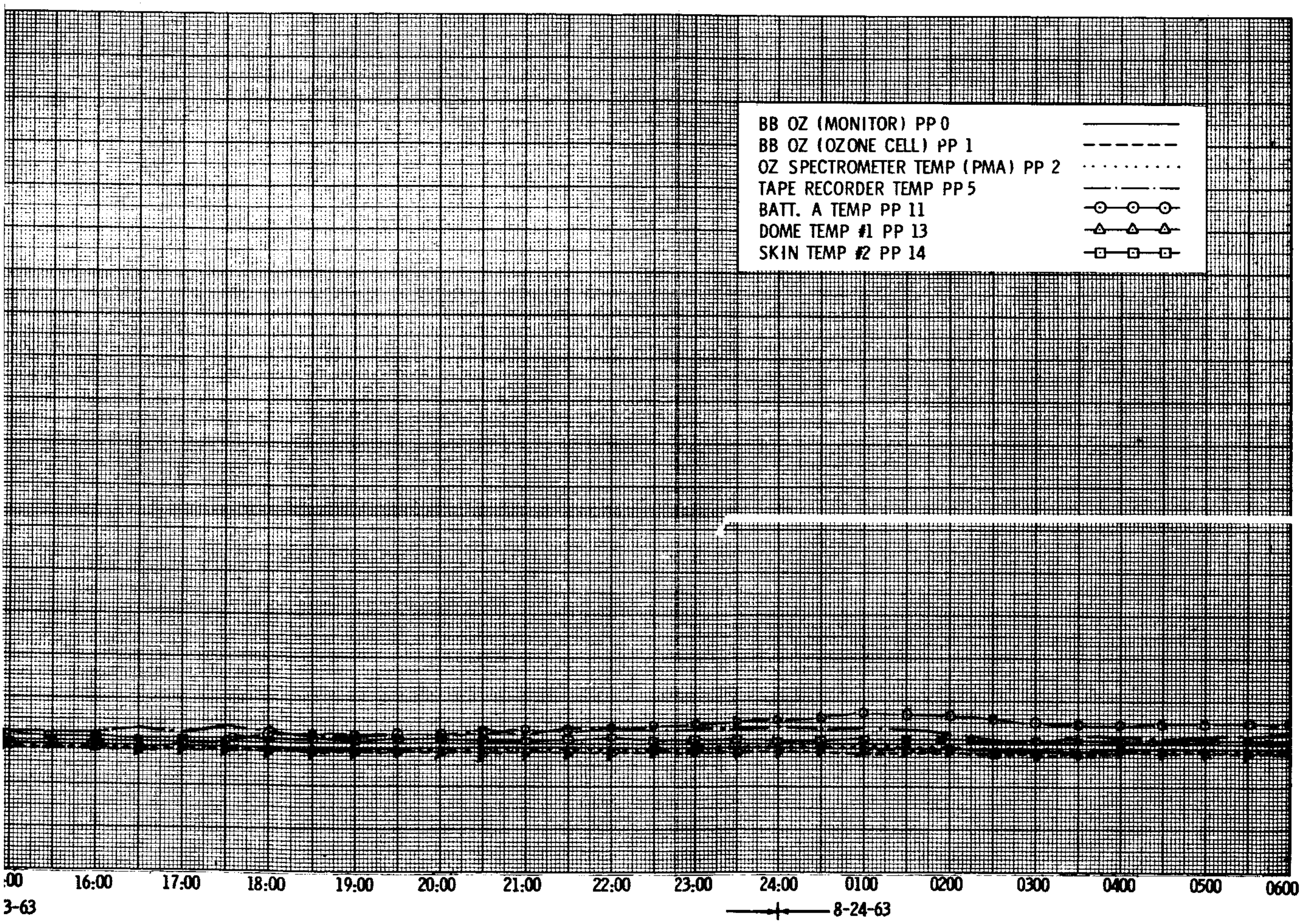


Figure 1-1—Thermal-Vacuum Te



lemetry Temperature Curves

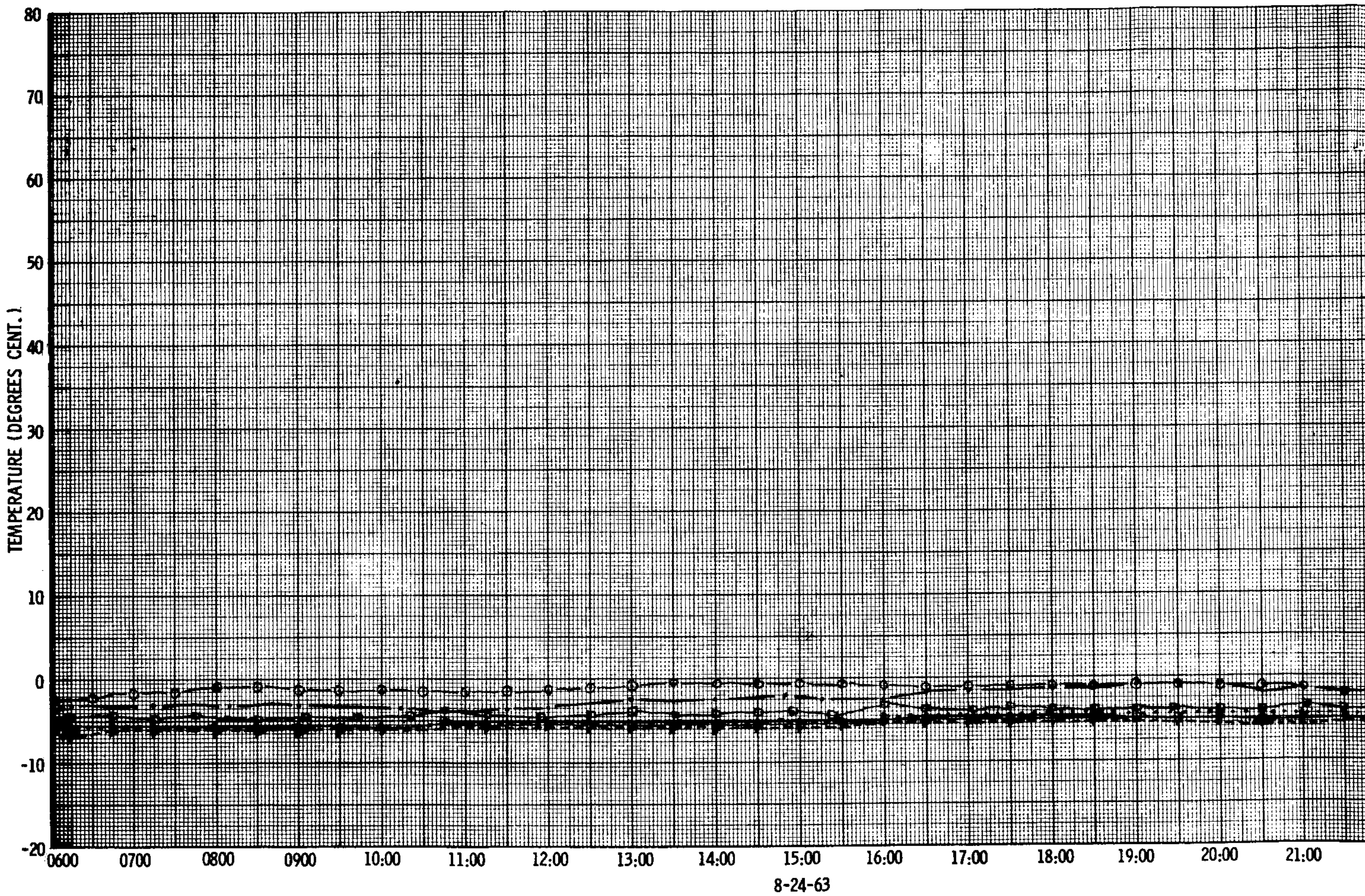
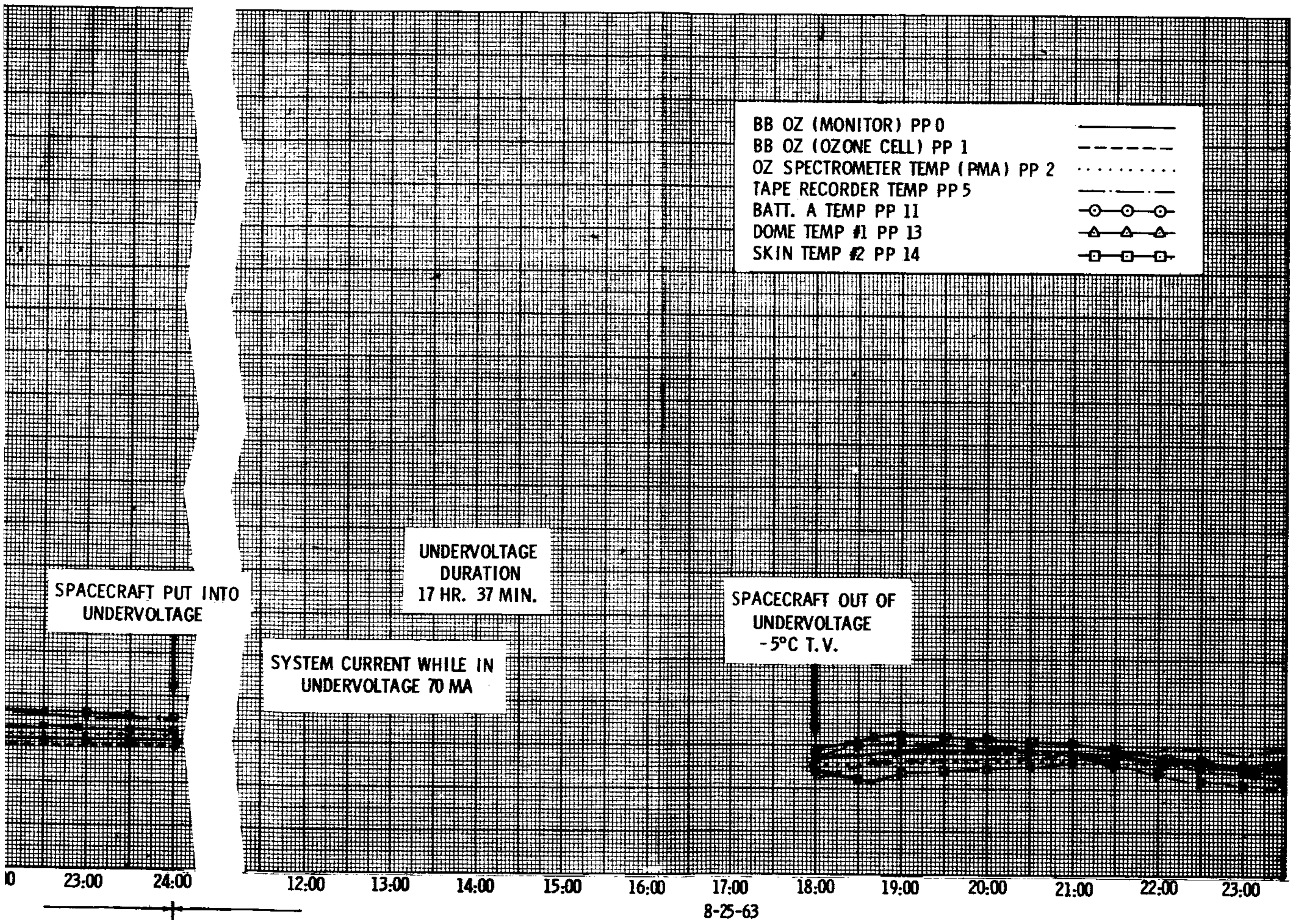


Figure 1-1—Thermal-Vacuum Telemetry



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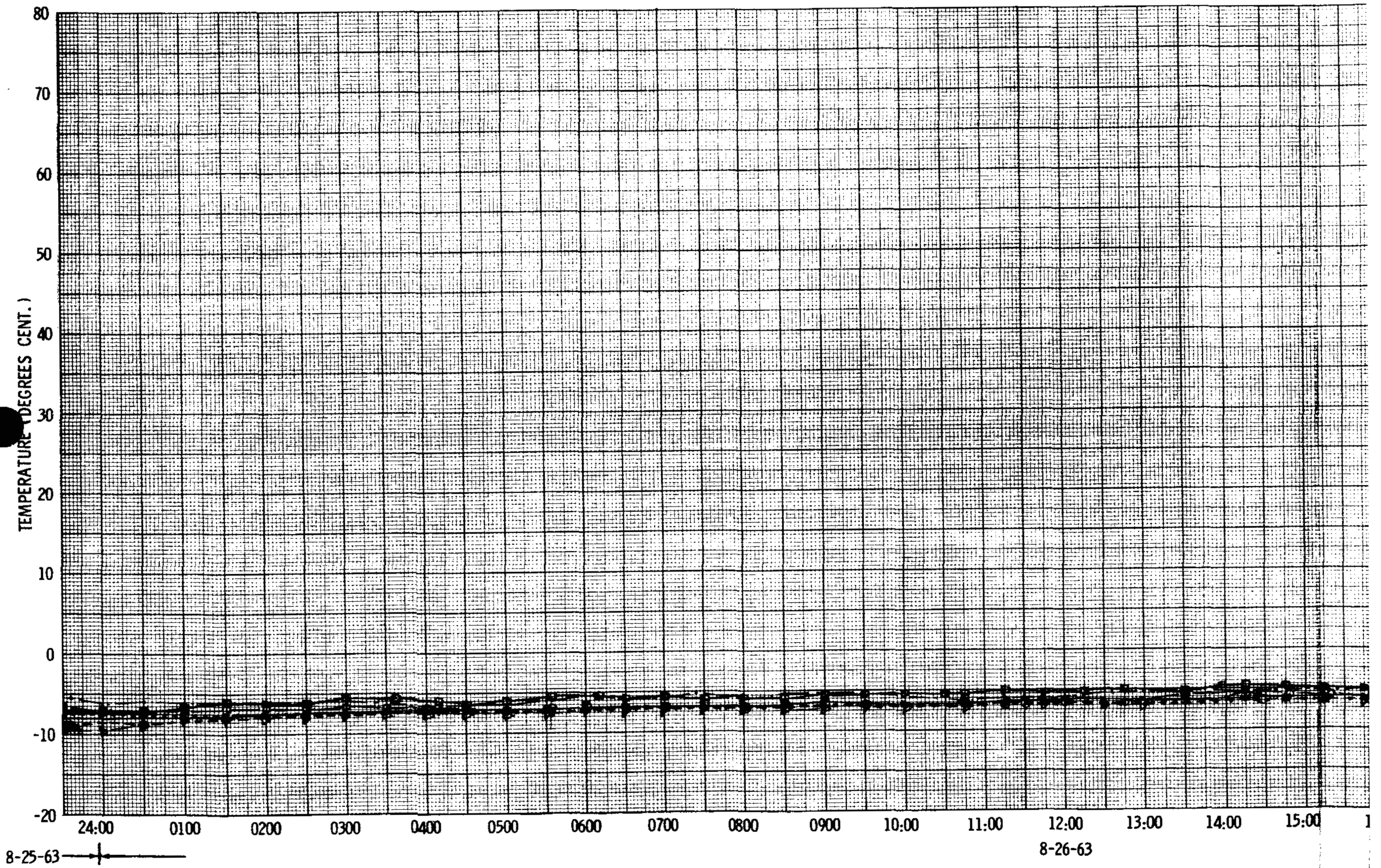
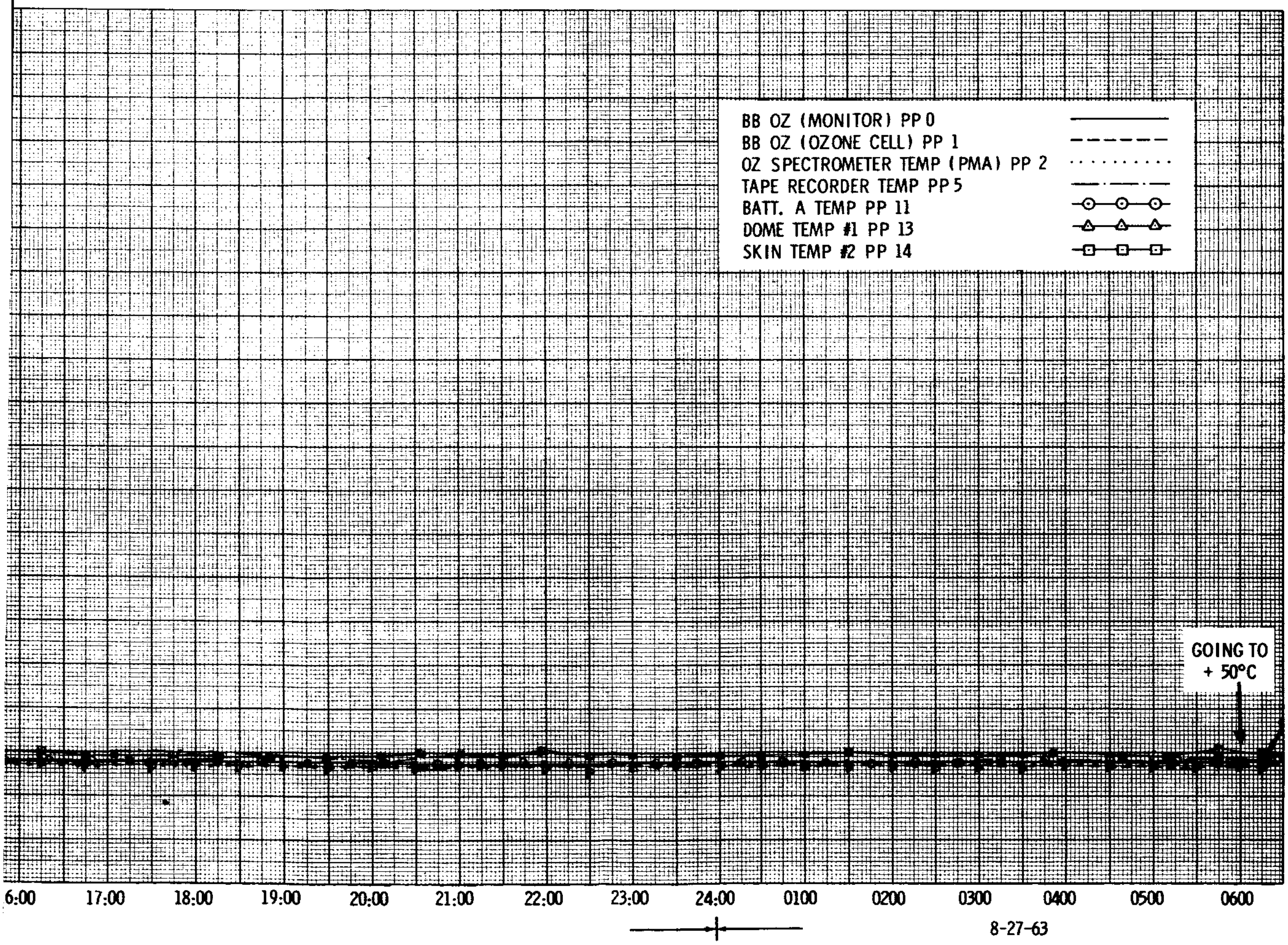


Figure 1-1—Thermal-Vacuum Telemetry Temp



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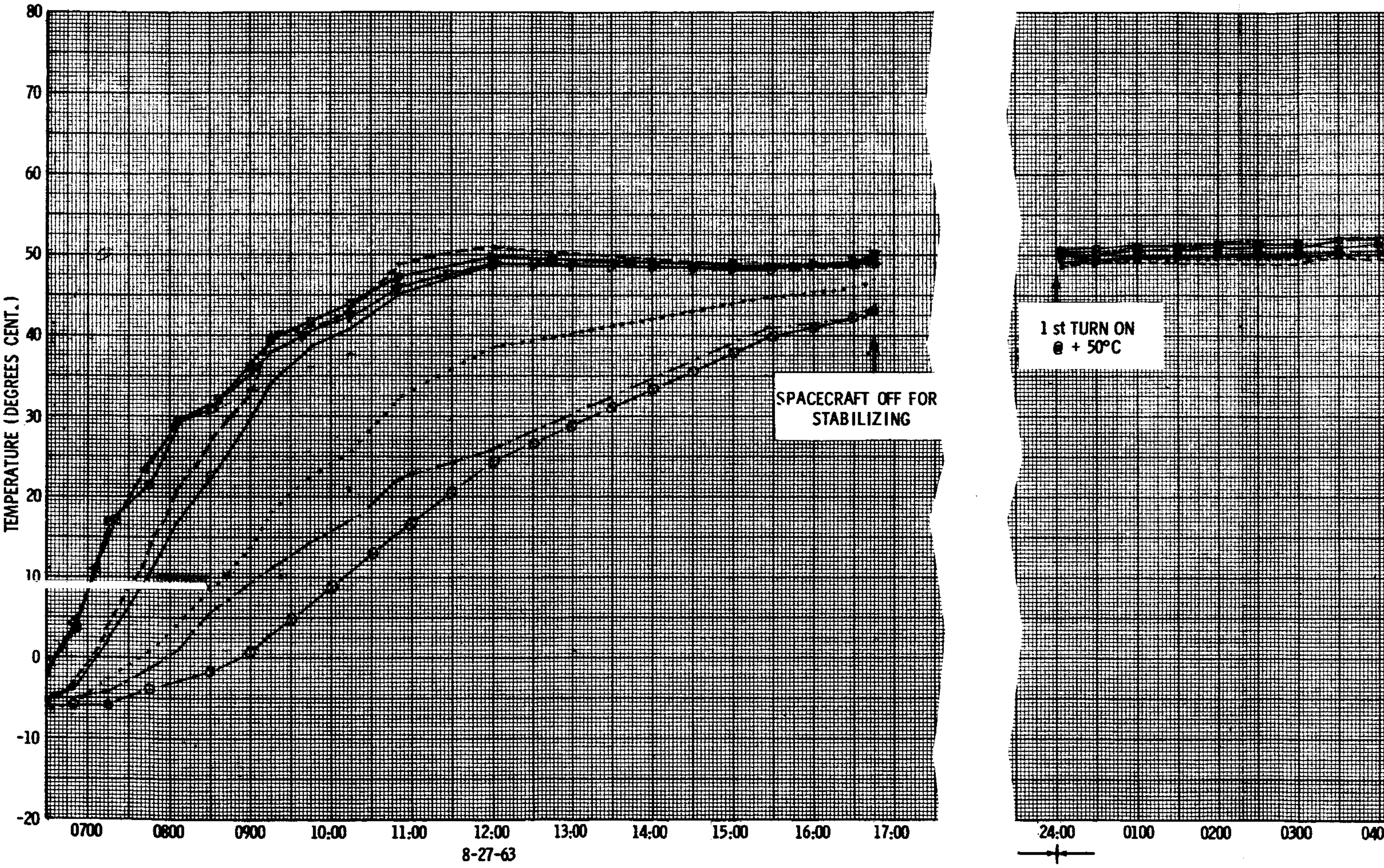
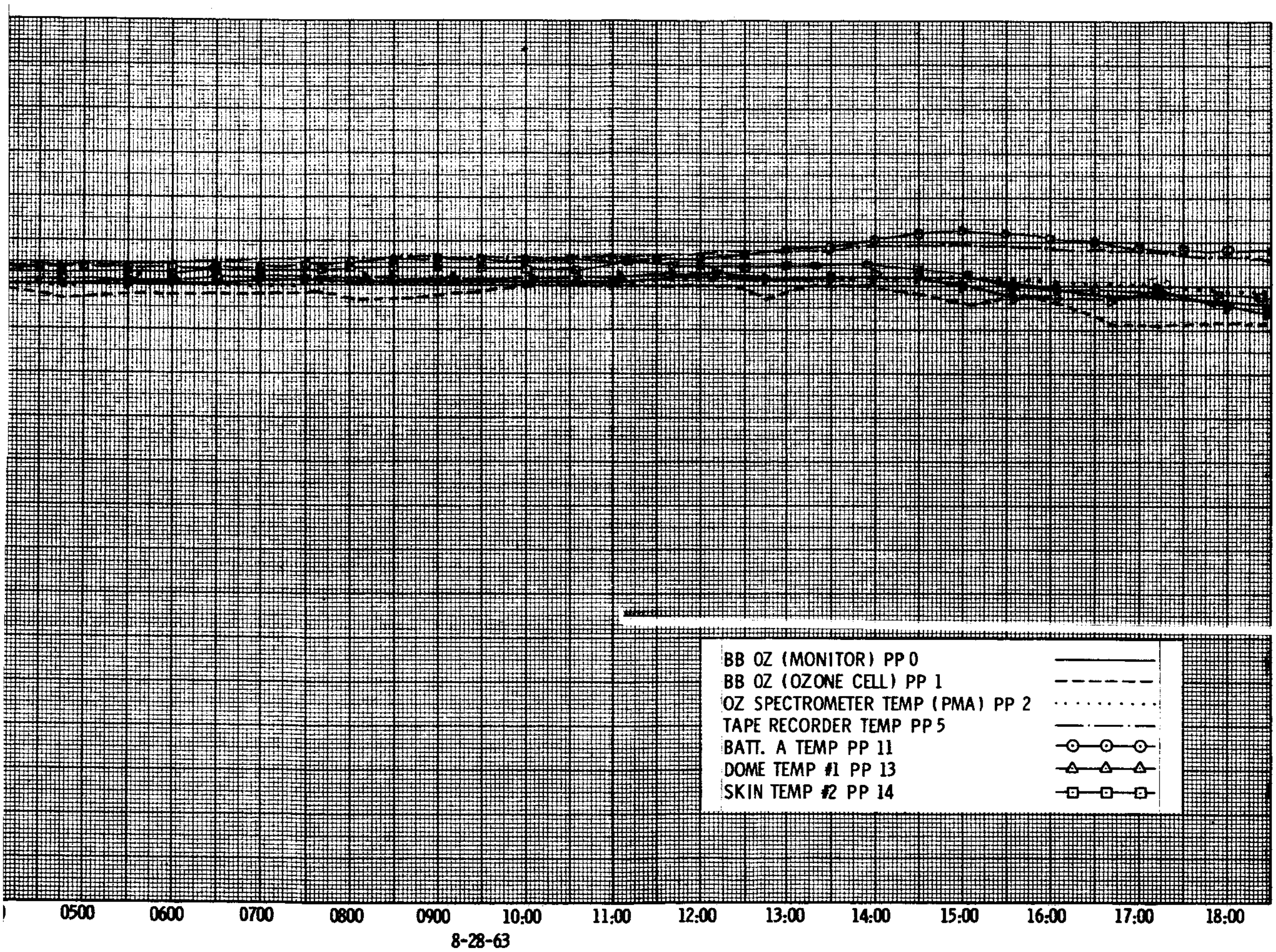


Figure 1-1—Thermal-Vacuum Telemetry Temp

1-4



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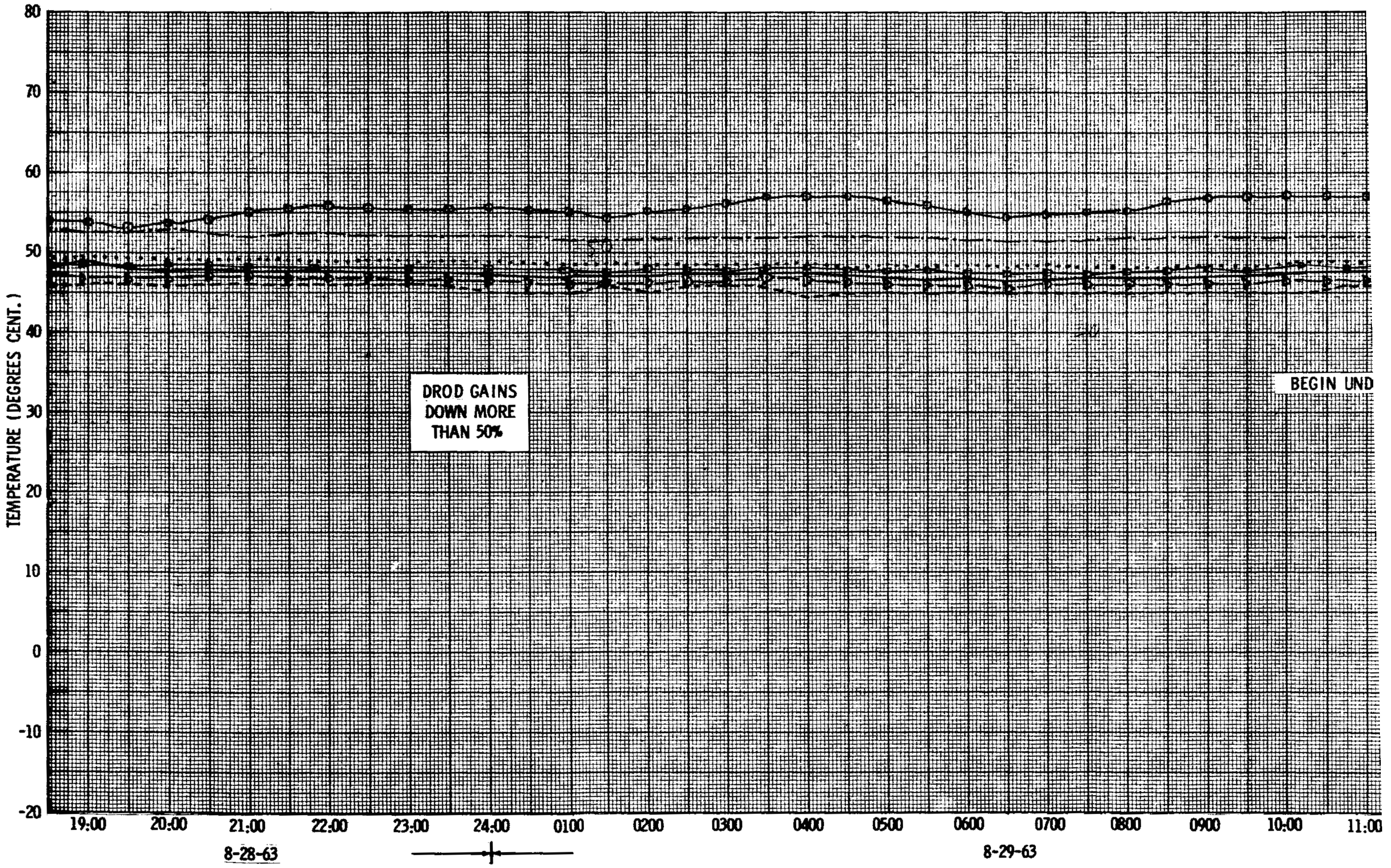
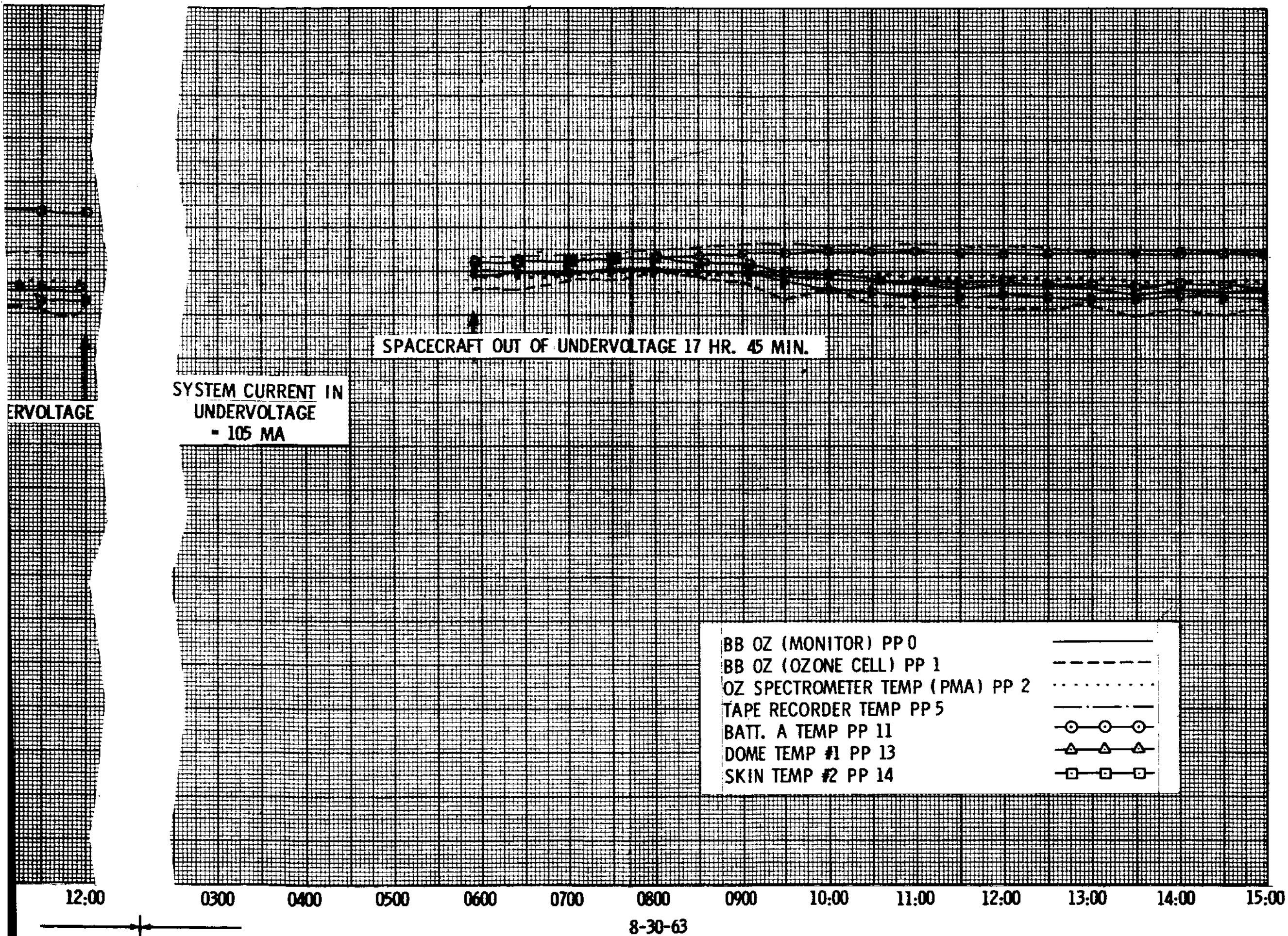


Figure 1-1—Thermal-Vacuum Telemetry Temp



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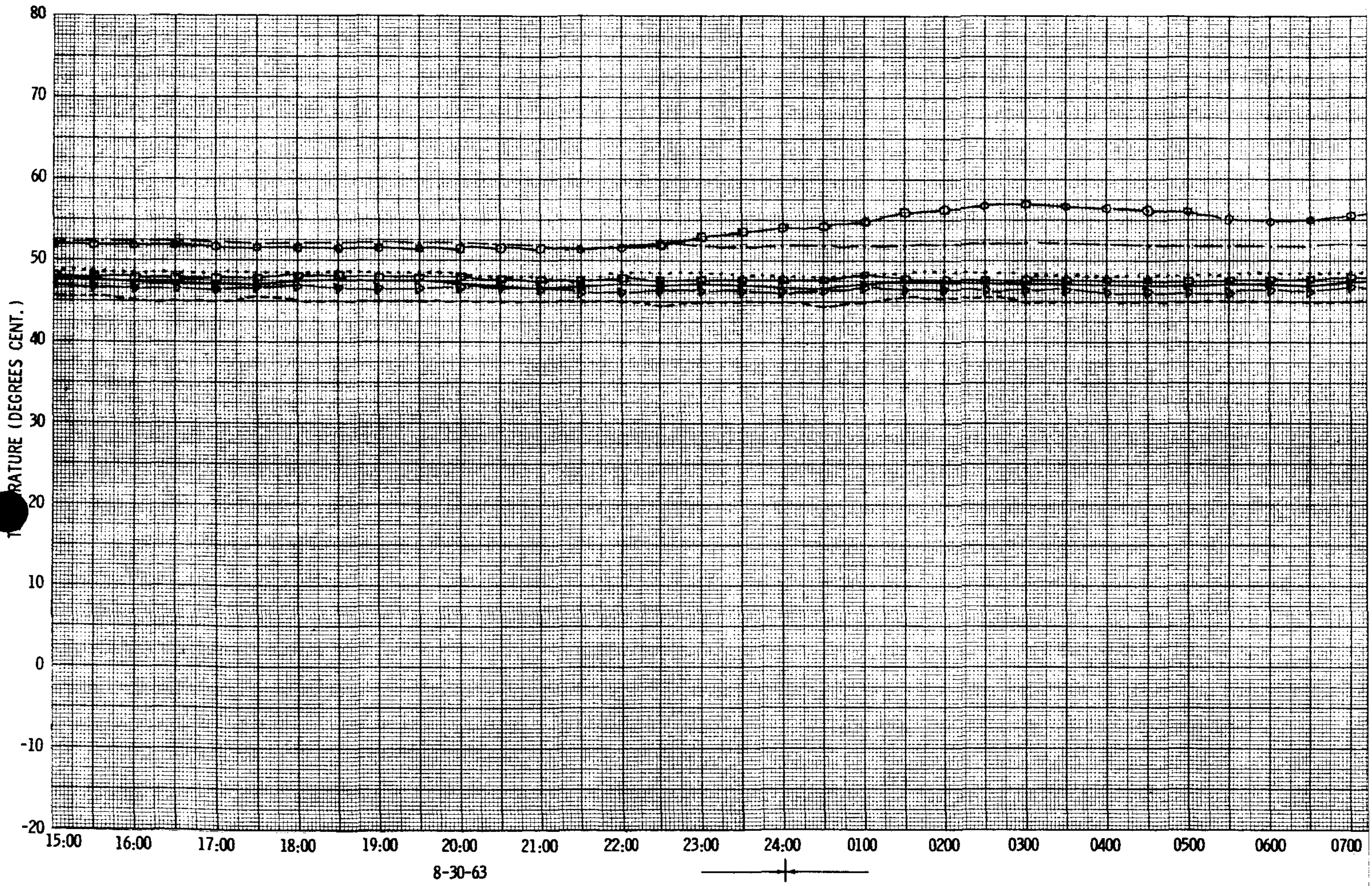
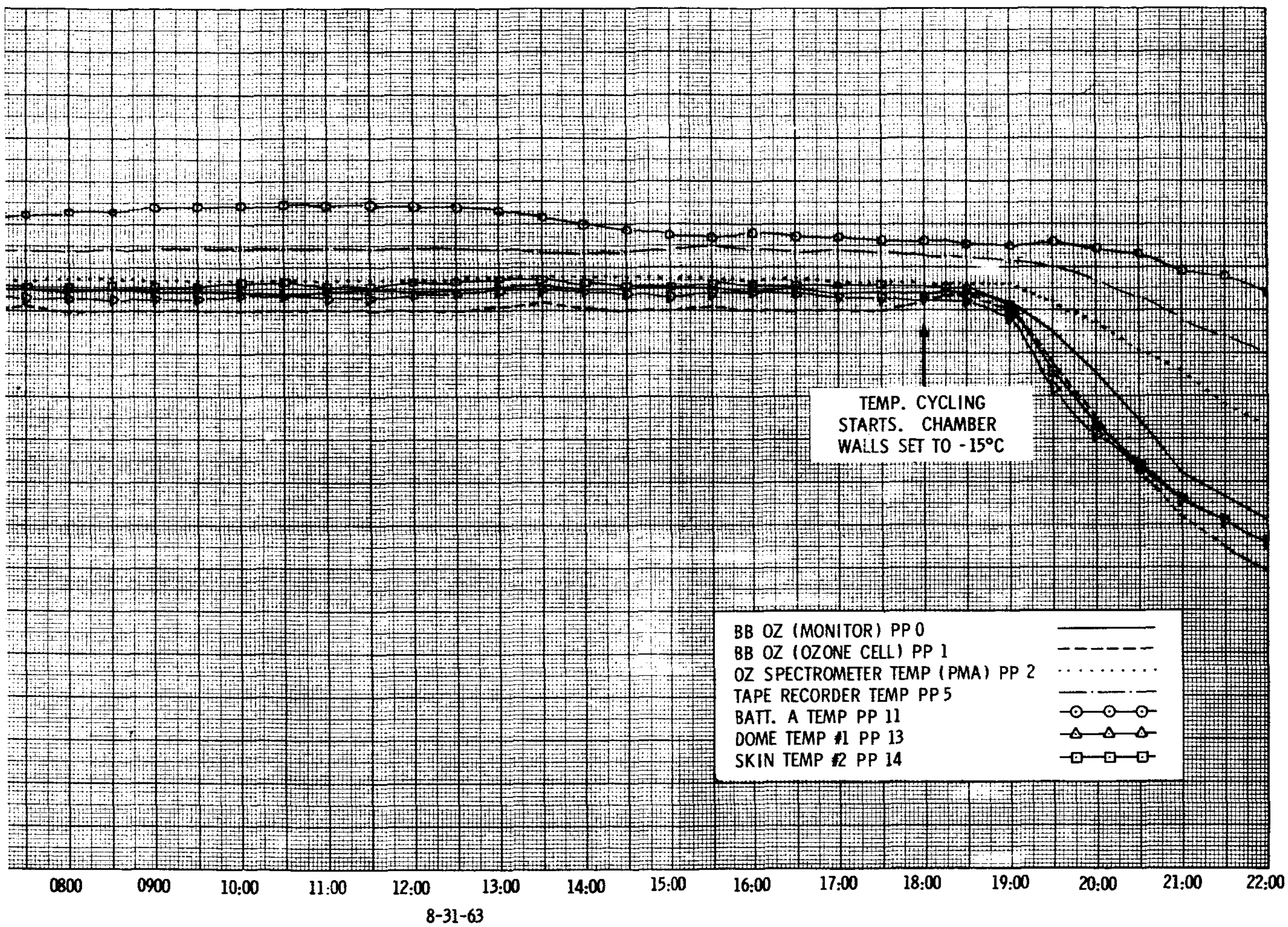


Figure 1-1—Thermal-Vacuum Telemet



·y Temperature Curves—Continued

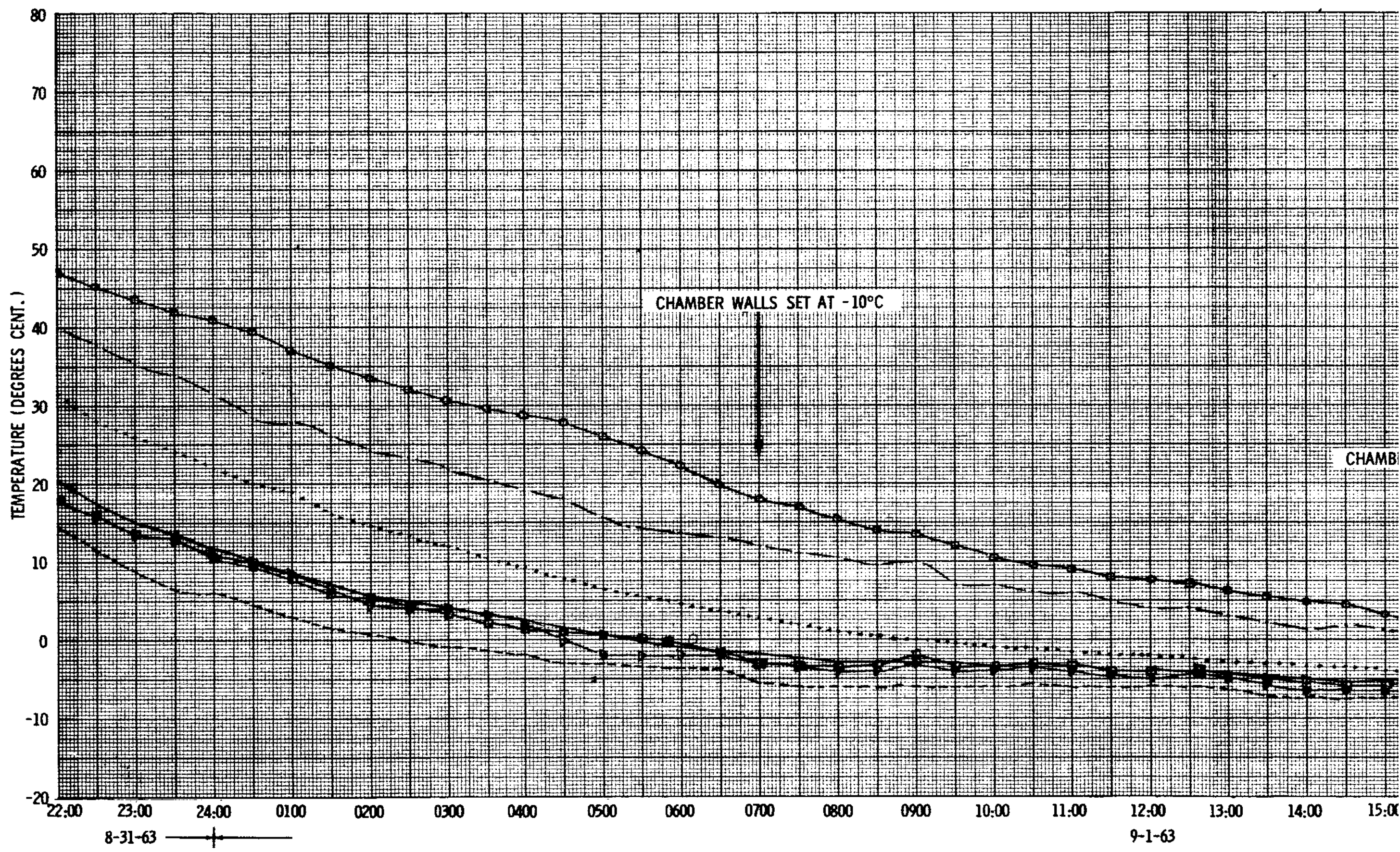


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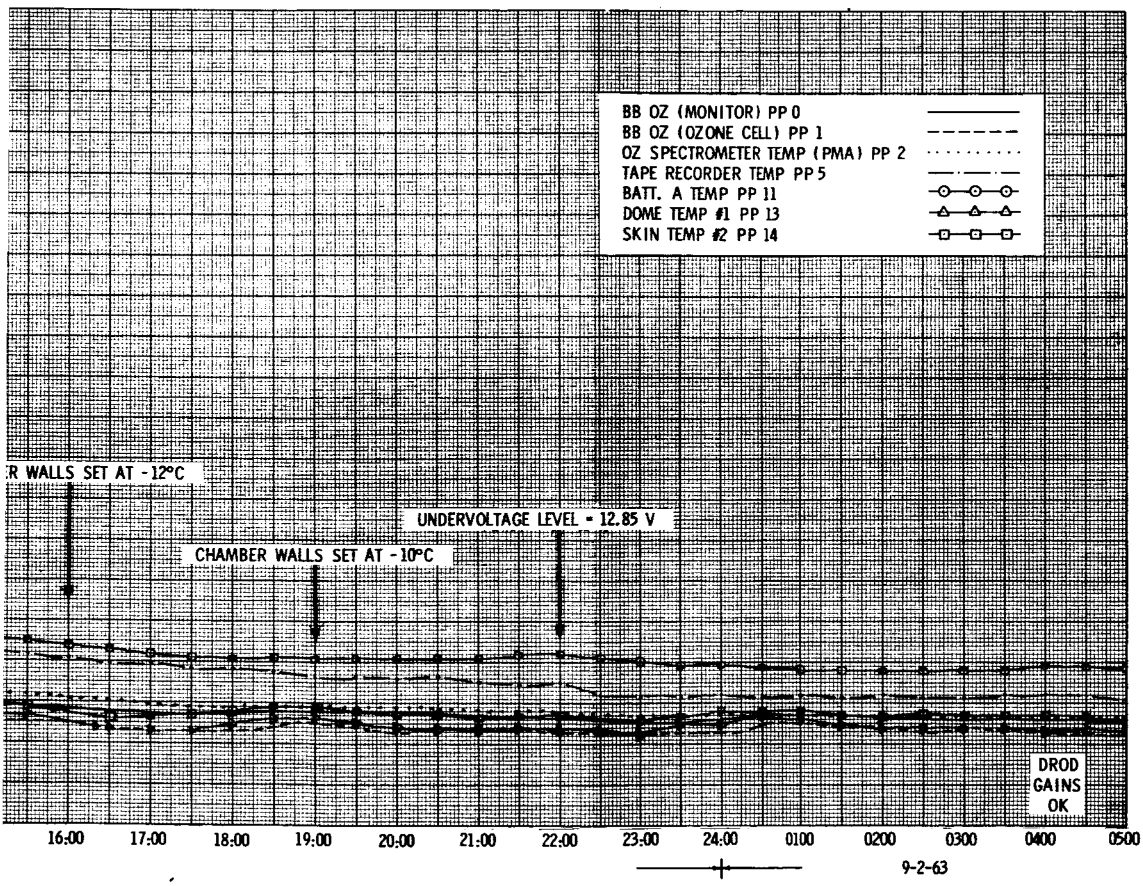
Figure 1-1—Thermal-Vacuum Telemetry Temper



ature Curves—Continued

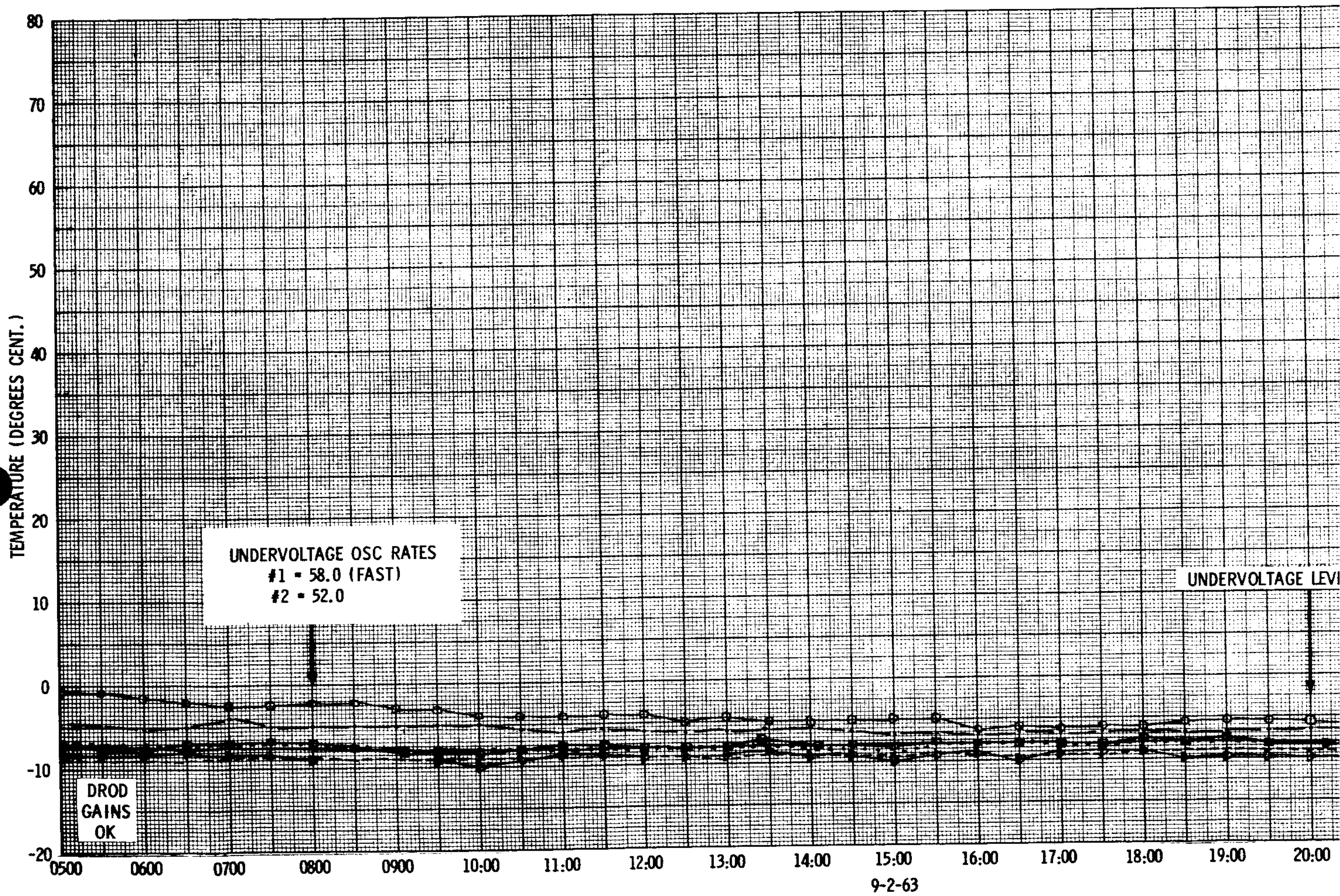
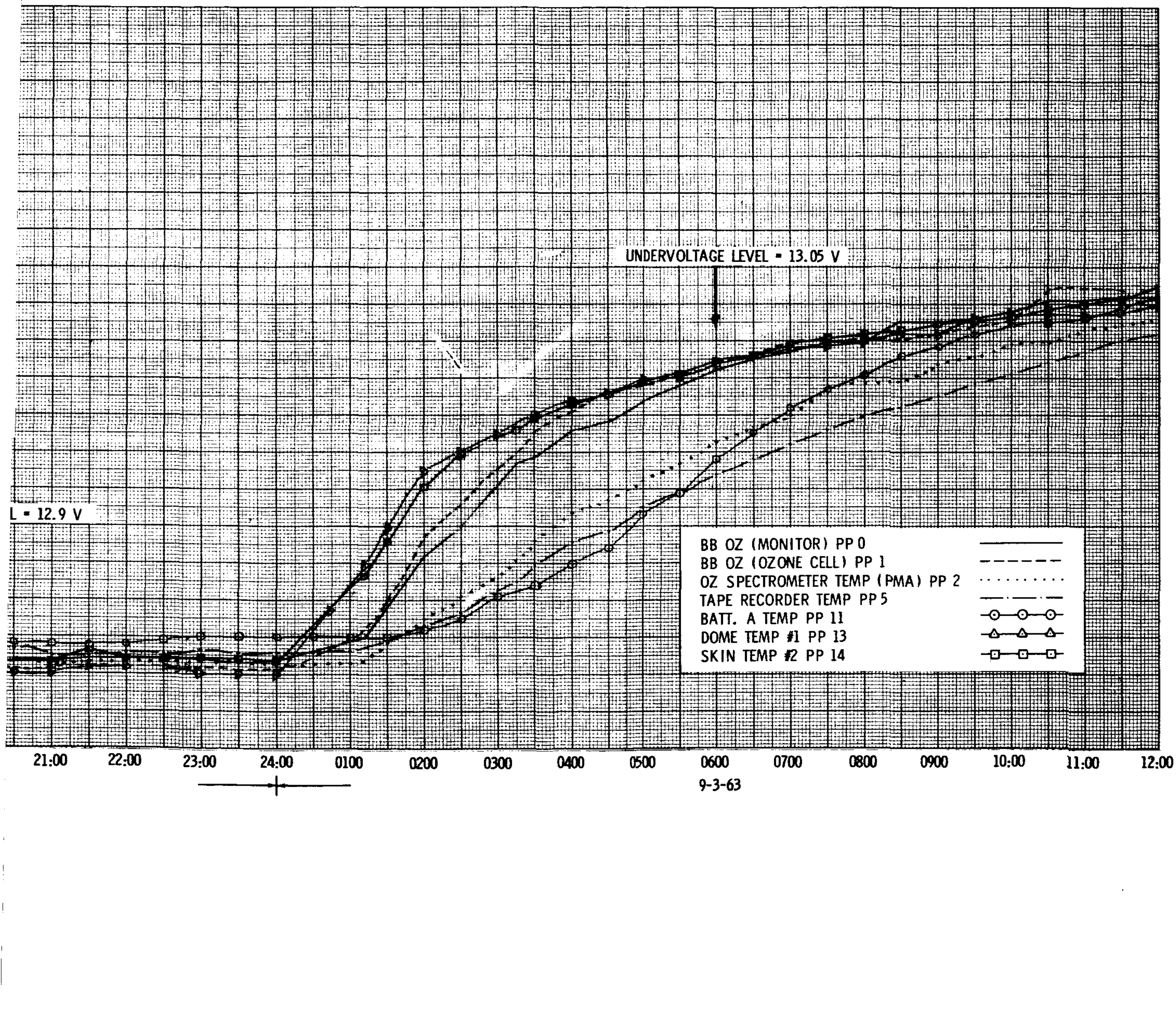


Figure 1-1—Thermal-Vacuum Te



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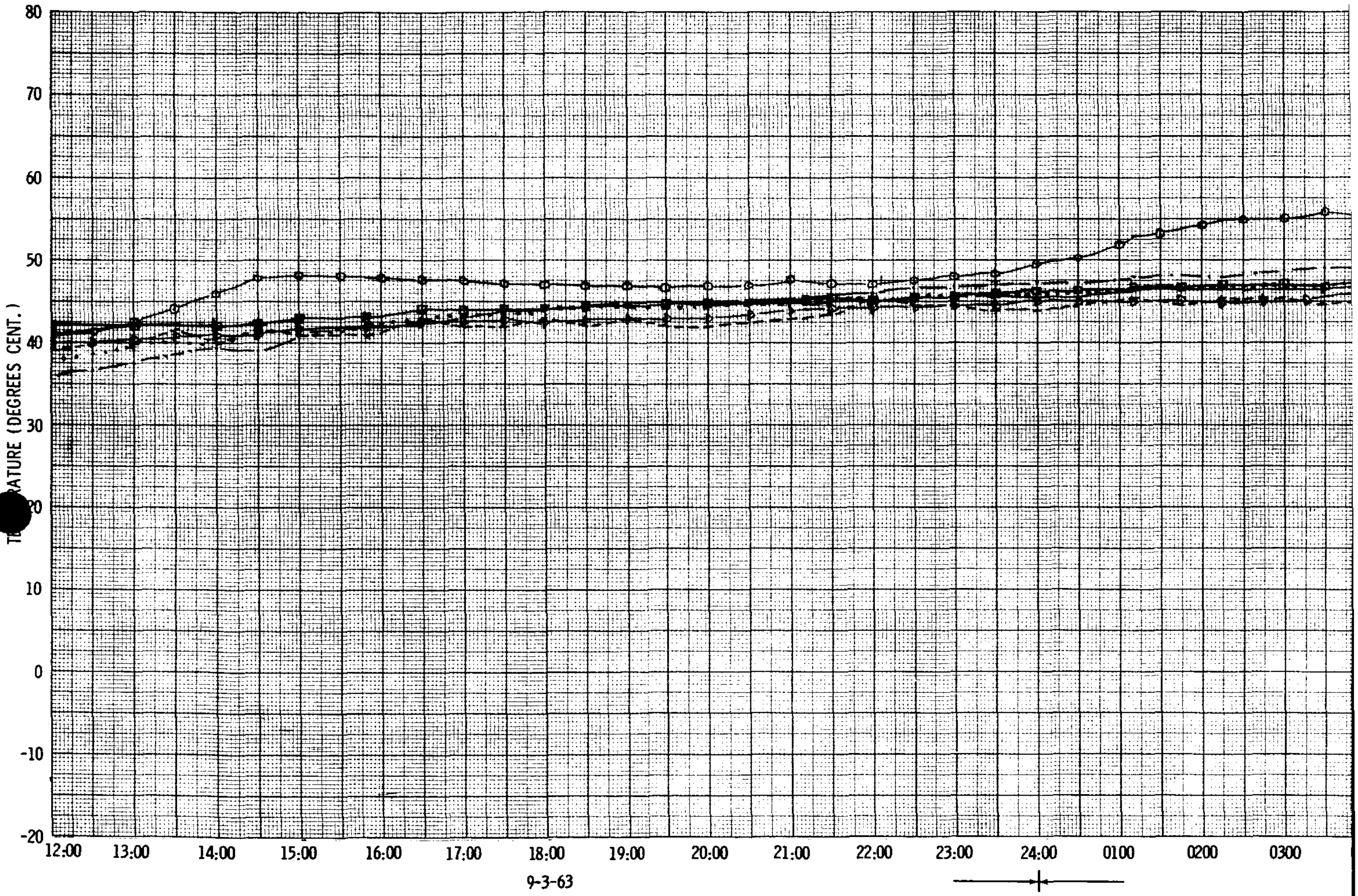
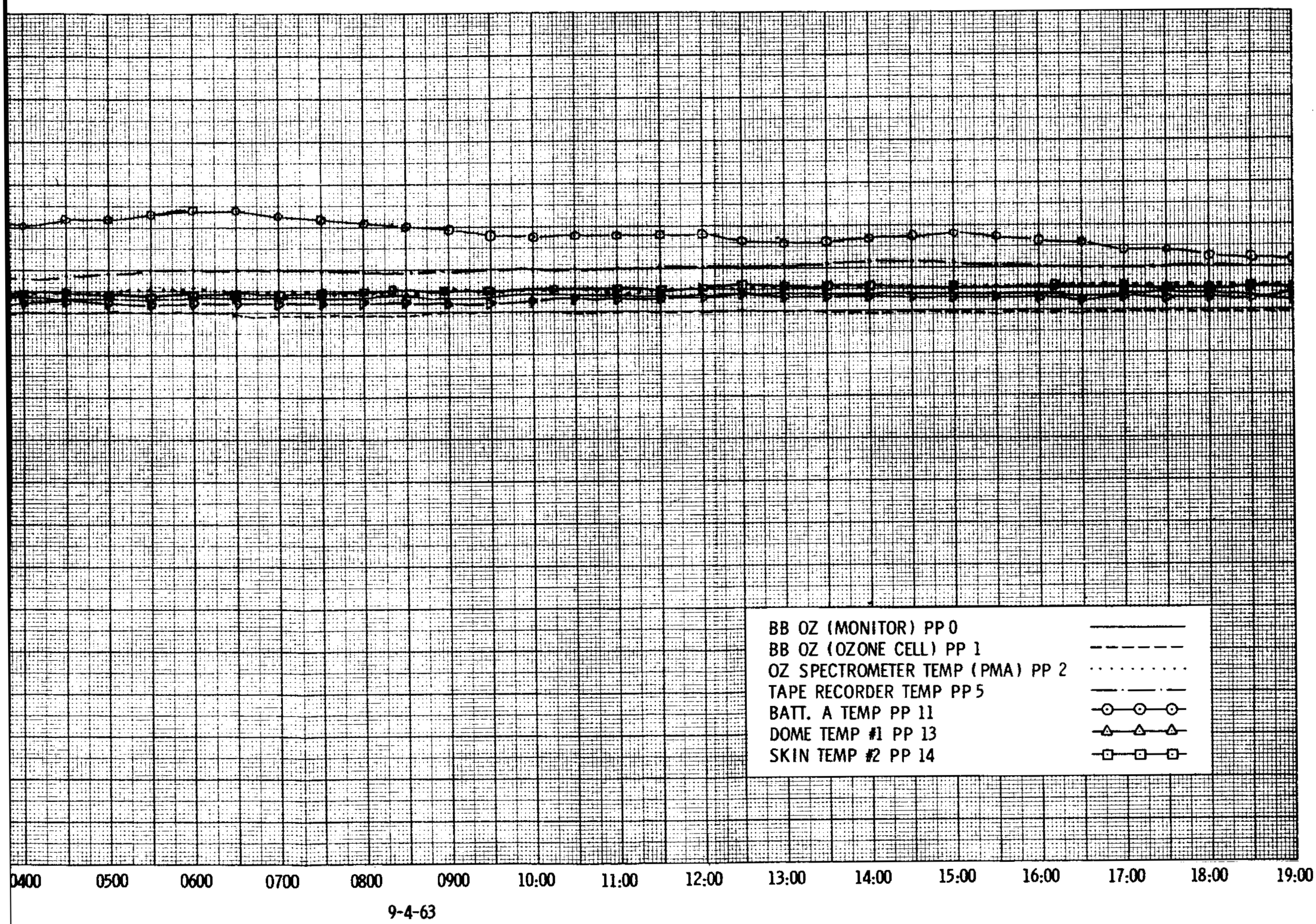


Figure 1-1—Thermal-Vacuum Telemet



·y Temperature Curves—Continued

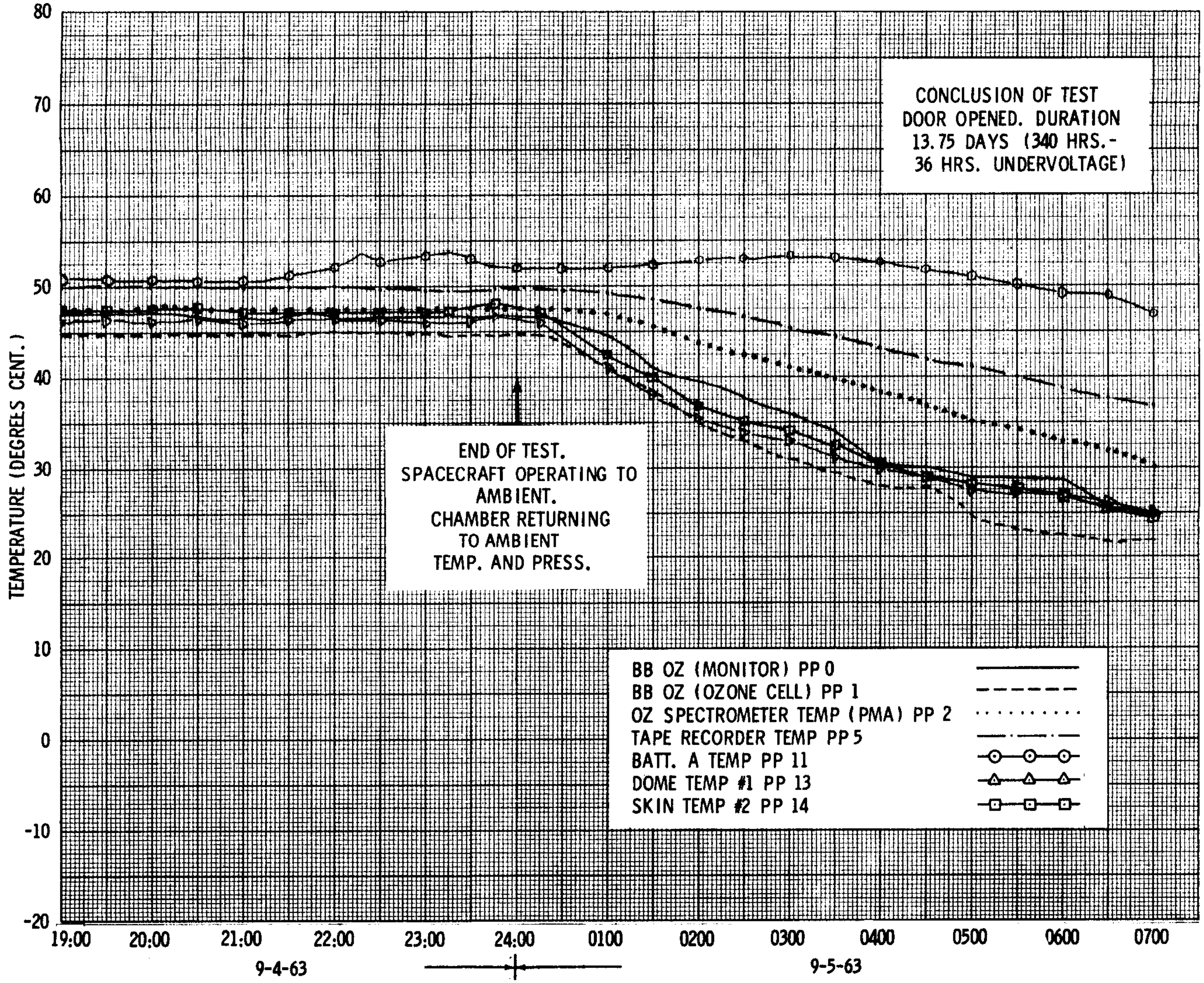


Figure 1-1—Thermal-Vacuum Telemetry Temperature Curves—Concluded

TABLE 1-1
PERFORMANCE SUMMARY

SUBASSEMBLY	SERIAL NUMBER	TEST CONDITION	PROBLEM	CAUSE	ACTION TAKEN	REMARKS
IRODS	106 110	Pre-T.V.	Noisy output	RF interference	Installed L-C filter at IROD preamp. input	
Undervoltage circuit	004	+ 50 C	Undervoltage level too high	Aging probably	Readjust firing level	One Schmitt fires @13.05 V, the other @12.2V.
MM-foil advance capacitor	Z-2 U 10	Found post T.V.	Fluid leaking from capacitor	Defective capacitor	Replaced both capacitors	Only one capacitor defective.
IRODS	106 110	Post-T.V.	Noisy output	RF interference power line for preamp. too noisy	Increased RF filtering. Found power-line stabilizer was connected in wrong part of preamp. circuit-Thus, causing amplification of power-line noise. Silicon cells were changed and mounted in an elastic material to eliminate some of the mounting stress and to provide more stable gain over temperature range.	All of these modifications were made on the flight-spare units which will be used. IROD serial numbers are 202 (A) and 204 (B).

2. PURPOSE

The purpose of these electronic tests was to determine that the S-52 flight 1 spacecraft would perform as intended during exposure to simulated orbital environments, and to provide information to designers and other personnel involved.

The S-52 flight 1 spacecraft configuration is shown in Figure 2-1. The subassemblies used in the flight 1 spacecraft are listed in Figure 2-2 and Table 2-1. These subassemblies completed at least one temperature cycle from -5°C to 50°C.

The solar paddles and the solar-paddle temperature sensor were not exposed during this test. The galactic-noise long-wire antenna was reeled and therefore not connected to the receiver input.

With respect to the prototype spacecraft, the following performance parameters were changed:

	From	To
PP 5	foil advance B (DROD)	Tape recorder temperature
PP 6	foil advance A (DROD)	Total dumping current
PP 8	galactic-noise reel	Galactic-noise reel and +12v

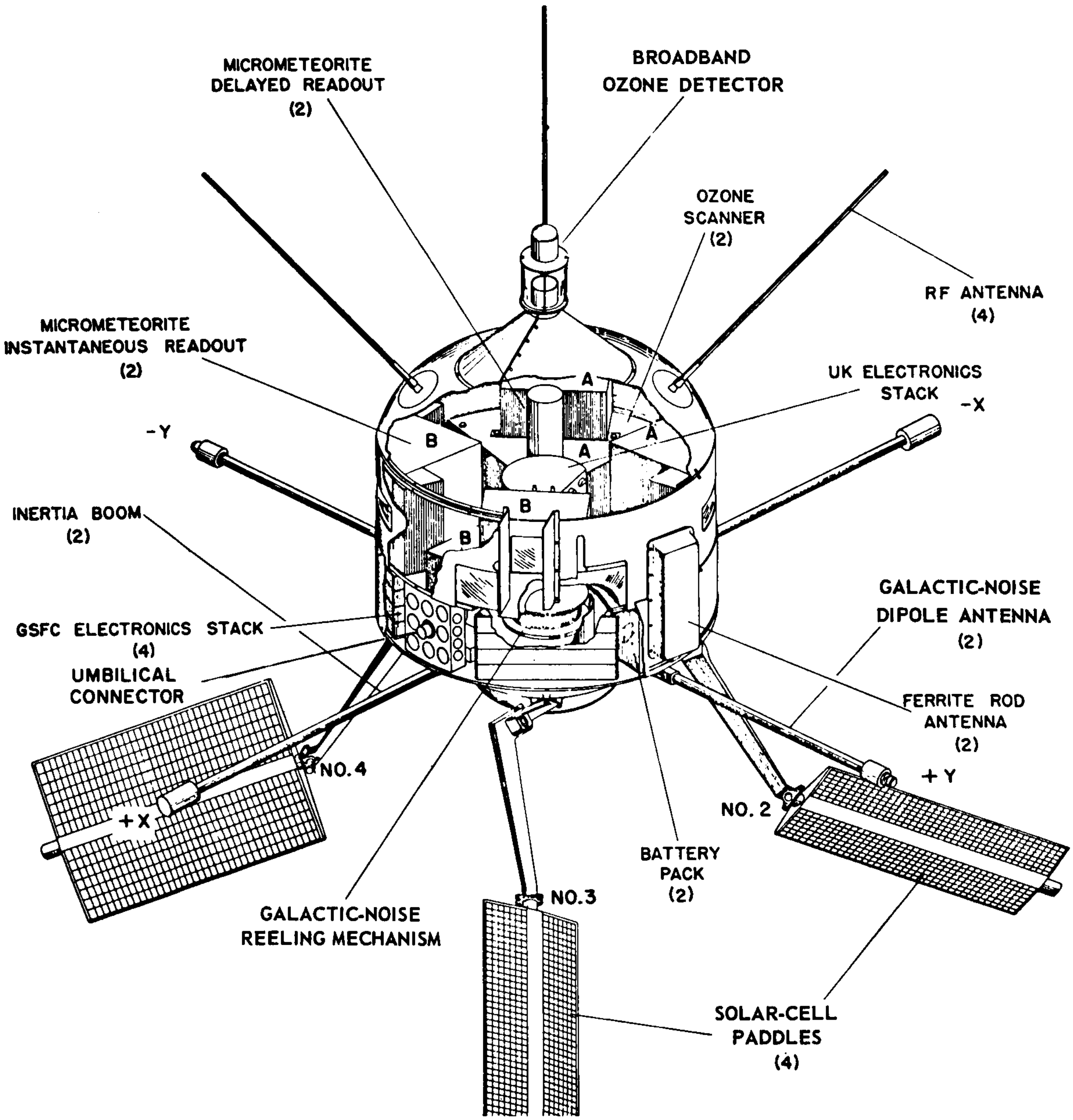
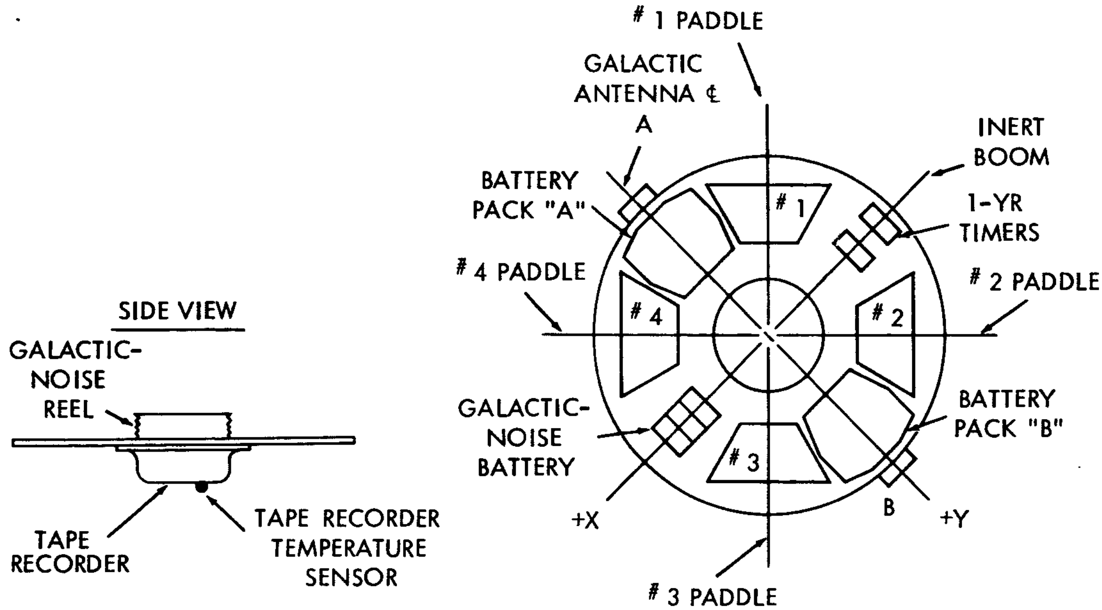


Figure 2-1—UK 2/S-52, International Satellite



Stacks start with Delta Pack "A" mounted directly on the platform and continued upward

	Stack #1 (brown)	SERIAL No.
A	- Transmitter	002
B	- Decoder	002
C	- Receiver	002
D	- Sample and hold circuit	002
	Stack #2 (red)	
A	- Power supply, + regulator	0005
B	- Recorder converter	002
C	- Data-storage control	004
D	- Programmer #1	001
	Stack #3 (orange)	
A	- Programmer #2	003
B	- Telemetry encoder #3	004
C	- Telemetry encoder #2	004
D	- Telemetry encoder #1	004
	Stack #4 (yellow)	
A	- Power supply, invertor	0002
B	- Battery switching network	002
C	- Undervoltage detector & recycle timer	004
D	- Power supply, regulator	002

		SERIAL No.	
Battery A		008	
Battery B		009	
1-yr timer A		38	
1-yr timer B		39	
Tape recorder		03	
RF coupler		7	
Antennas	a	F1	
	b	F2	
	c	F3	
	d	F4	
Solar paddles	a	3 NP	Not tested
	b	6 NP	
	c	1 NP	
	d	4 NP	
Solar paddle temp.			
Tape recorder temp.			

Figure 2-2-UK 2/S-52 Equipment Layout, Lower Deck

TABLE 2-1
UK-2/S-52 EQUIPMENT LAYOUT, UPPER DECK

OZONE EXPERIMENT	SERIAL#
Ozone Elect.	C529
a. Oz Temp Mon	8
b. Mon Amp	6
c. Oz Amp	6
d. Spect Amp A	6
e. Spect Amp B	6
f. HT Converter	6
g. EHT Converter	7
Photomultiplier A	6
Photomultiplier B	7
Oz spectrometer A	3
Oz spectrometer B	4
Broadband detector	B 50/2

GALACTIC-NOISE EXPERIMENT	SERIAL#
Galactic-noise receiver	F2
Galactic-noise Batt A	003
Galactic-noise Batt B	003
Ferrite rod A	2-29
Ferrite rod B	2-31
Galactic-noise reel mech	F2

MICROMETEORITE EXPERIMENT	SERIAL#
IROD A	106
IROD B	110
DROD A	107
DROD B	108
Volt Stab. A	A
Volt Stab. B	B
Capacitor "Z"	2
Capacitor "U"	10
Selector	110, 111, 112
Trigger	103
Preamp A	8
Preamp B	9

3. ENVIRONMENTAL EXPOSURE

Figure 1-1 shows the temperature excursions and durations of exposure experienced by the S-52 flight 1 spacecraft. Measurements from spacecraft temperature sensors which appear as performance parameters on the telemetry format were received and decoded at the instrumentation complex. The temperature measurements were displayed at the test stand in μsec (average period of 10-period measurements of the frequency in the data burst). These measurements were converted to engineering units (°C), and plotted concurrently against time. Correlation was made with sensor calibration curves and measurements from local hardline environmental transducers.

To complete the history of the spacecraft in this exposure, Figure 1-1 lists major events.

For detailed information on planned exposures, see T&E Specification S-1-301.

3.1 MOUNTING CONFIGURATION

The S-52 flight 1 spacecraft was mounted in the vertical position on a dolly-supported chamber fixture. Figure 3-1 shows the spacecraft mounted on the fixture before entering the chamber.

3.2 INSTRUMENTATION

The S-52 instrumentation complex shown in Figure 3-2 is described in detail in "Electronic Test Procedures for the Environmental Design Qualification and Flight Testing of the UK-2/S-52" (X-324-63-113, February 15, 1963).

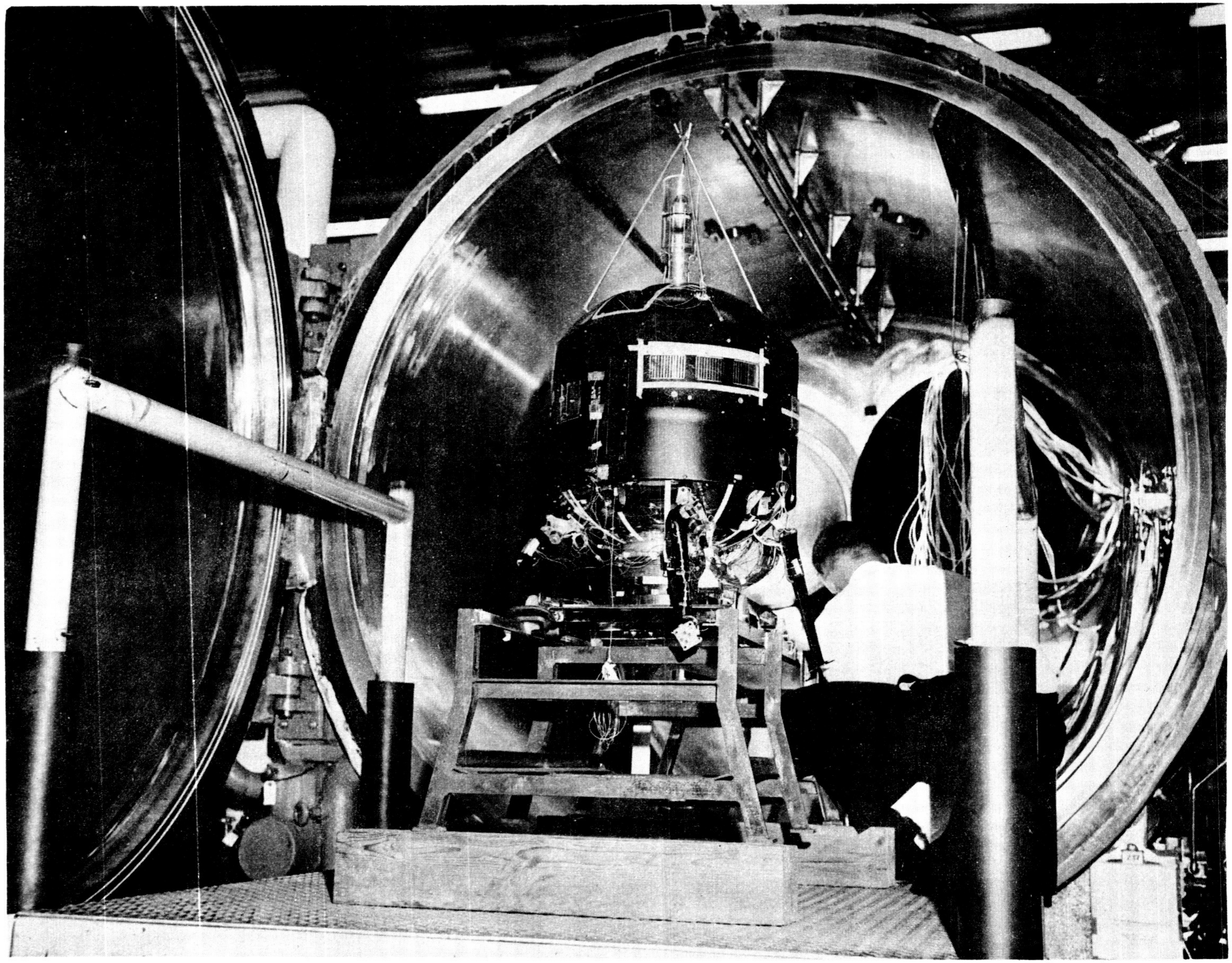


Figure 3-1—S-52 Spacecraft Preparatory to Entering 8 by 8 Thermal-Vacuum Chamber

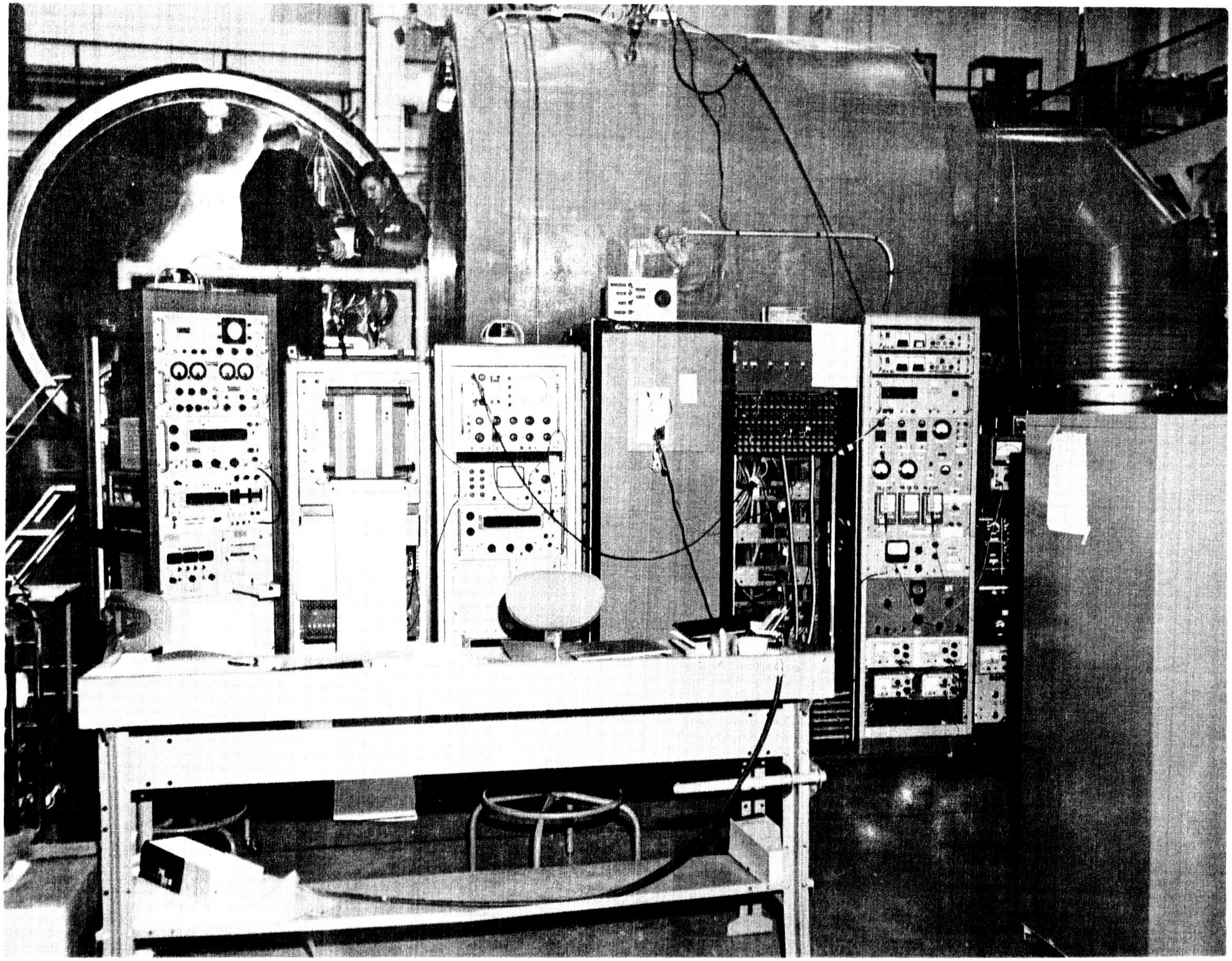


Figure 3-2—S-52 Instrumentation Complex for the Collection and Analysis of Telemetry and Hardline Data

The instrumentation complex consists of the control, measuring, recording, and display equipment with its associated interconnections.

It provides for:

a. Exercise of the spacecraft power and programmer functions

b. Stimulation of spacecraft experiments

c. Monitoring, recording, and displaying of subsequent operational responses

d. Surveillance of other available operating test-point parameters to determine that the spacecraft is performing as intended throughout the environmental exposure

Stimulus for the ozone experiment was provided by the 2500-watt mercury-xenon lamp shown in Figure 3-3. The light beam from the lamp was directed through the quartz window of the chamber. Appropriately positioned mirrors reflected the light into experiment sensors. The fixture, housing the lamp, oscillated over a 45-degree angle to provide dynamic excitation and to permit excitation of all experiment sensors. This exciter was developed by Rudolph Meiner of the Technical Support Section, Test and Evaluation Division. The galactic-noise experiment was excited through an inside antenna fed from a signal generator located outside the chamber.

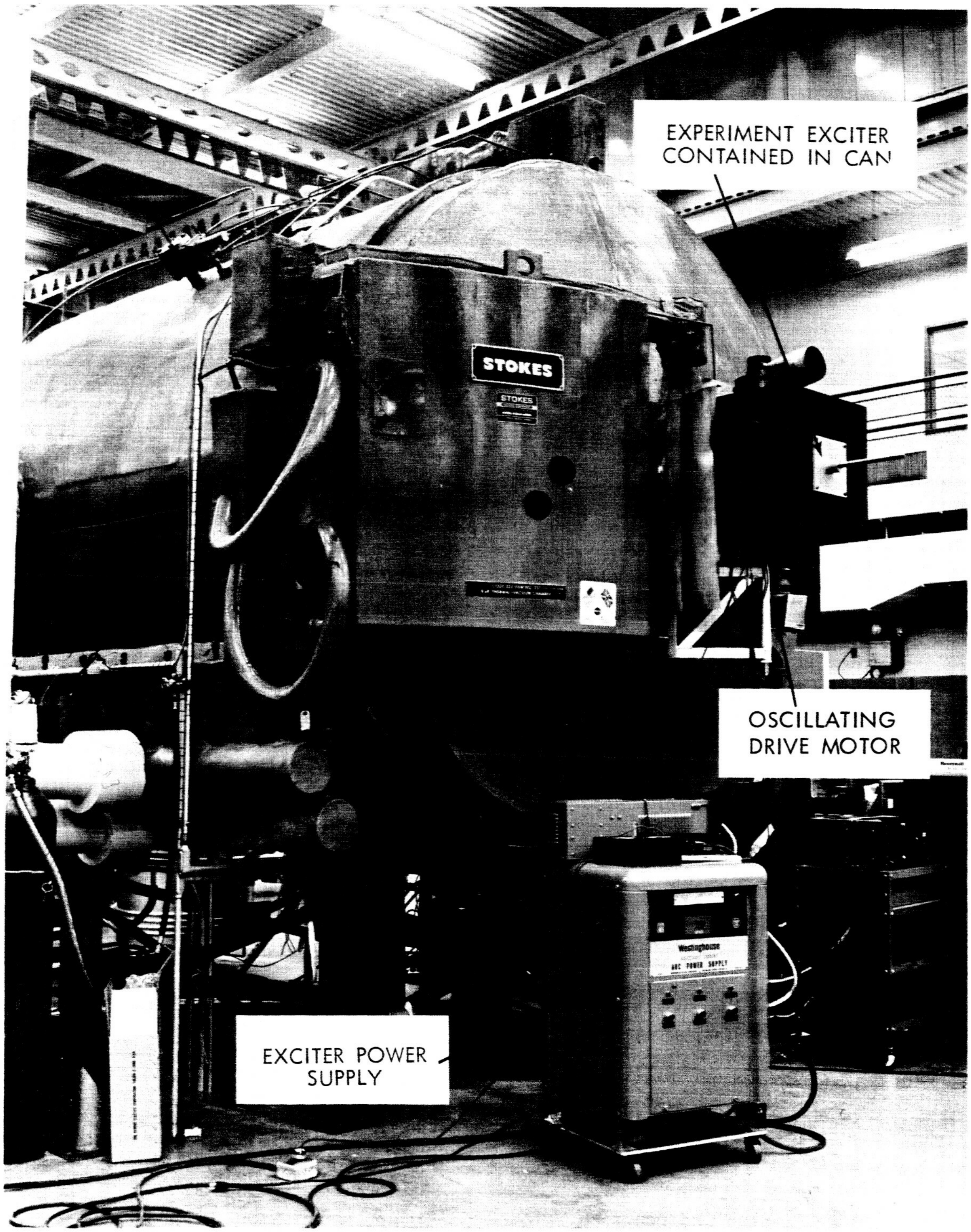


Figure 3-3—Experiment Exciter Mounted

4. TEST PROCEDURES

Unit-type test procedures, described in "Electronics Test Procedures for the Environmental Design Qualification and Flight-Acceptance Testing of the UK-2/S-52," Report X-324-63-113, were used to collect and evaluate data.

A set of unit-type test procedures constitute a complete electrical systems test of the spacecraft performance. However, by segmenting the complete systems test procedure into unit form, each in itself an entity, the electronics test conductor acquires the ability to institute, at his discretion, test units commensurate with the status, configuration, and exposure of the spacecraft. A complete systems test was performed at least once every 6 hours while the spacecraft was under exposure.

A continual chronological history of the normal and abnormal events experienced by the spacecraft during the exposure was recorded in the flight 1 log book. At least every half-hour a magnetic tape recording was made of the received spacecraft telemetry video. All playbacks of the spacecraft recorder and any abnormal operations were recorded on the test-stand tape recorder with an accompanying voice description.

As shown in Figures 4-1 and 4-2, the test-unit procedures were carried out in a manner compatible with the spacecraft programmer functions. This made efficient concurrent tests of the programmer and the experiments possible.

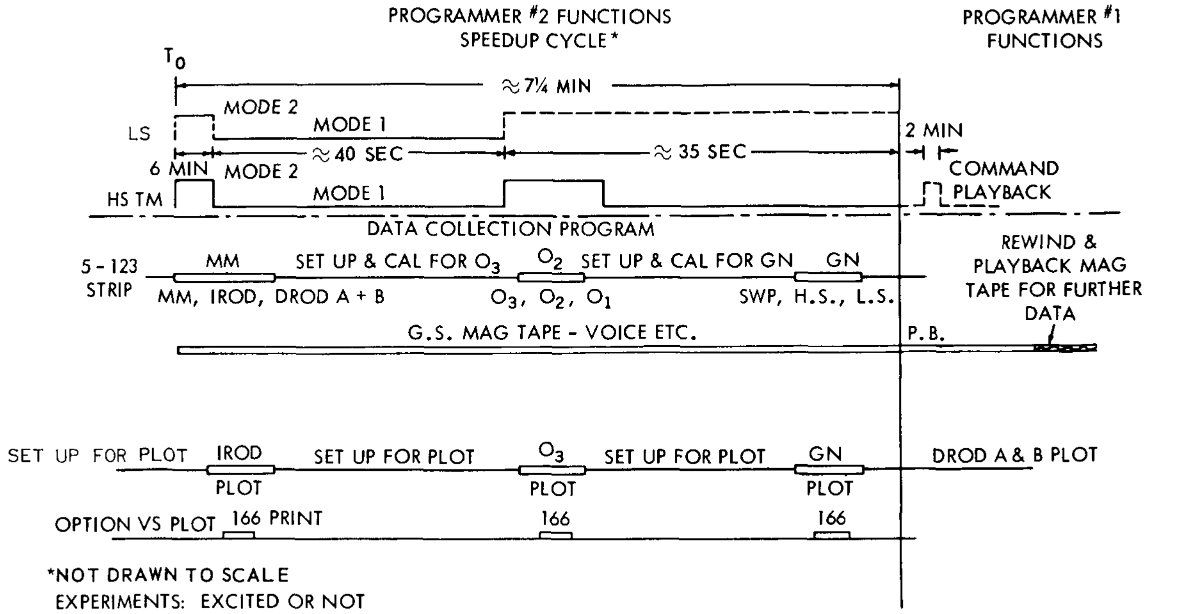


Figure 4-1—Data Collection During Programmer #2 Speedup Cycle

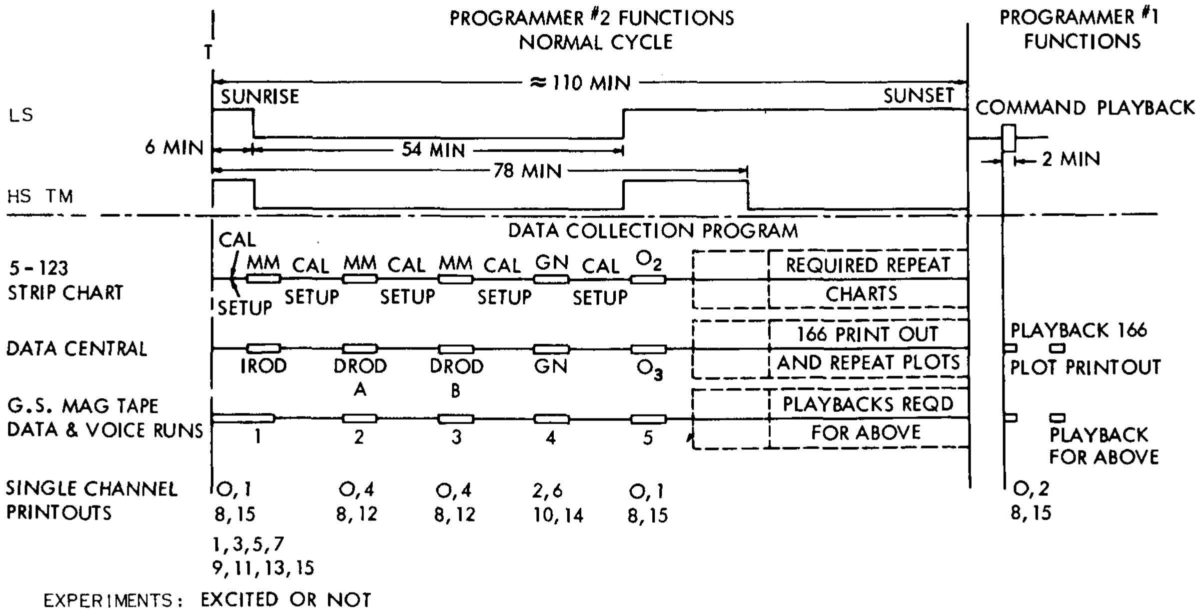


Figure 4-2—Data Collection During Programmer #2 Normal Cycle

Close surveillance of the spacecraft operation was made through the use of the performance parameter data sheet (Table 4-1), in which entries were made about every 20 minutes when the spacecraft was in the mode 1 condition. These entries include: a check of the high-speed encoder-oscillator sync and frame indentification frequencies as acquired from a minimum of six sequences of channel zero; the average

TABLE 4-1
PERFORMANCE PARAMETER DATA SHEET

Performance Parameters		Spacecraft Condition			Spacecraft Condition			Spacecraft Condition			Spacecraft Condition			Spacecraft Condition			Spacecraft Condition		
		Date Time			Date Time			Date Time			Date Time			Date Time			Date Time		
S52–PP	Frame	µSec	Volts	Eng. Units	µSec	Volts	Eng. Units	µSec	Volts	Eng. Units	µSec	Volts	Eng. Units	µSec	Volts	Eng. Units	µSec	Volts	Eng. Units
Ozone snout T	0																		
Monitor T	1																		
Spect photo T	2																		
Solar paddle T	12																		
Skin temp #1	13																		
Skin temp #2	14																		
Unreg Buss volts	7																		
Solar current	9																		
Batt A Chrg – Dischrg	10																		
Batt A temp.	11																		
EHT Mon	3																		
+ 15 volts	4																		
GN reel +12V	8																		
GN sweep	15																		
Total dumping 1	6																		
Tape recorder temp.	5																		

	Test Condition	Test Condition	Test Condition	Test Condition	Test Condition	Test Condition
	Performed by	Performed by	Performed by	Performed by	Performed by	Performed by
	LS Sync					
	µsec					
	HS Sync	Remarks	Remarks	Remarks	Remarks	Remarks
GN Sweep 1 µsec	Frame µsec					
2	0					
3	1					
4	2					
5	3					
6	4					
	5					
	6					
Tape Recorder Environ-	7					
ment Temperature (°C)	8					
	9					
	10					
	11					
	12					
	13					
	14					
	15					

value of low-speed sync applied to the tape recorder (from 6 measurements); and the average values for the spacecraft performance parameters from six sequences of channel 8.

Spacecraft temperature performance parameters were converted to engineering units and correlated with local environmental transducer measurements. These data were then used to establish calibration curves at chamber temperature stabilization and to provide for the plotting of Figure 1-1. The temperature of the tape recorder (thermocouple #4) was also recorded to maintain close surveillance of this critical component.

The following channel 8 parameters were correlated with the respective hardline voltage and current measurements:

- PP3 – EHT monitor
- PP4 – +15 volts
- PP6 – total dumping period
- PP7 – unregulated buss
- PP8 – +12 monitor
- PP9 – solar paddle currents
- PP10 – battery current
- PP15 – GN sweep monitor

Six sequential values of PP15, galactic-noise sweep monitor, were recorded on the performance parameter data sheet, converted from μsec to voltage values, and correlated with hardline strip charts and discriminator strip charts of the galactic-noise sweep (Table 4-1).

At each stabilization temperature, calibration curves of the power performance parameters PP6, 7, 9, and 10 were established to provide data to permit more accurate determination of operation during orbit.

4.1 UNIT A

The unit A data sheet (Table 4-2) provides for the recording and performance check of all internal spacecraft system voltages available at the monitor panel. Also included are the transmitter power and frequency. All voltage measurements were made with an isolated input digital voltmeter, and with the charging current OFF to minimize the effects of ground currents. The data sheet provides the monitor panel pin designations of the described voltages and the permitted tolerances.

TABLE 4-2
UNIT A DATA SHEET

Spacecraft Condition:			Code:		By:	Date:	Time:
		Tolerance					
Pin	Description	Hi	%	+%	Lo	Value	
25	Signal Ground						TRANSMITTER POWER
10	+ 3.00	3.15	5	5	2.85		250 mw nominal (measured at
11	+ 7.50	7.51	1/4	1/4	7.48		spacecraft)
27	+ 6.00	6.06	1	1	5.94		Value
28	+12.00	12.1	1	1	11.8		
45	+15.0	15.1	1	1	14.8		
44	+ 6.50	6.82	5	5	6.17		Method of test (attenuation)
46	Unreg Buss	16.5	5	5	12.5		
43	- 3.00	3.07	1/4	1/4	2.92		
26	- 4.00	4.2	5	5	3.8		
12	-18.0	18.1	1	1	17.8		TRANSMITTER FREQUENCY
9	- 6.00	6.06	1	1	5.94		136.56 $\pm$ 0.002%
14	- E.H.T.						+ = 136.5627312
49	GN Batt Neg						- = 136.5572688
32	GN Batt A						
33	GN Batt B						
8	15 VAC	15.7	5	5	14.2		Value
42	1700 cps						

Under method of test the RF attenuation, and the length and type of coax cable used between the spacecraft and the measuring instruments were recorded.

4.1.1 UNIT A PROCEDURE

4.1.1.1 Check of Spacecraft System Voltages

a. Turn off spacecraft charging voltage.

b. Check calibration of isolated input digital voltmeter.

c. Connect negative lead of digital voltmeter input to pin 25 (spacecraft ground) on the monitor panel.

d. Record spacecraft conditions: date, time, environment, etc.

e. Measure and record the dc-voltage values in the unit A data sheet (Table 4-2).

f. Measure and record the amplitude and frequency of the 15 vac on the scope and counter respectively.

   (1) Channel A input pins 8 and 42

   (2) Scope vertical output to counter input frequency

g. Verify that the above measurements are within specified tolerances.

4.1.1.2 Check Transmitter Power and Frequency

a. Measure and record transmitter power.

b. Under "Method of Test," record type and length of cable, and attenuation used.

   1. Check power meter zero before connection for measurement.

c. Measure and record transmitter frequency.

   1. Check counter calibration prior to measurement.

4.2 UNIT A_1

Unit A_1 provides for the measurement and recording of the spacecraft system voltages, the transmitter power and frequency, a recording of the high-speed sync, and the performance parameters.

Unit A_1 was performed every hour the spacecraft was in the continuous operation. This provided a profile of spacecraft performance and readily displayed performance trends (Table 4-3).

4.2.1 UNIT A_1 PROCEDURE

4.2.1.1 Check of Spacecraft System Voltages (See unit A procedure.)

4.2.1.2 Check of Transmitter Power and Frequency (See unit A procedure.)

4.2.1.3 Check of Spacecraft Performance Parameters

a. System-charging current set consistent with exposure

   NOTE: During low-temperature exposure, the charging rate is applied for 60 minutes and removed for 40 minutes consistent with orbital conditions. During the high-temperature orbit, charging current is applied 100 percent of the time consistent with a full sunlight orbit. The amount of charging current may be varied at the test conductor's discretion to determine effects on spacecraft operation and battery performance.

b. Measure and record battery current, charging current, and charging voltage.

TABLE 4-3

UNIT A_1 DATA SHEET

Spacecraft Condition		Code:		By:		Date	Time:	
Pin	Description	Tolerance Hi	%	+%	Lo	Value	High Speed Sync	Period
25	Signal Ground						0	
10	+ 3.00	3.15	5	5	2.85		1	
11	+ 7.50	7.51	1/4	1/4	7.48		2	
27	+ 6.00	6.06	1	1	5.94		3	
28	+12.00	12.1	1	1	11.8		4	
45	+15.0	15.2	1	1	14.8		5	
44	+ 6.50	6.82	5	5	6.17		6	
46	Unreg buss	16.5	5	5	12.5		7	
43	- 3.00	3.07	1/4	1/4	2.92		8	
26	- 4.00	4.2	5	5	3.8		9	
12	-18.0	18.1	1	1	17.8		10	
9	- 6.00	6.06	1	1	5.94		11	
14	-EHT						12	
49	GN Batt Neg						13	
32	GN Batt A						14	
33	GN Batt B						15	
8	15 VAC	15.7	5	5	14.2		Low - speed sync	
42	1700 cps						Frame 0	
	Battery A current				Charging v			
	Charging current							
A	Channel 8 & 0 recorded check						Transmitter frequency	
B	Rustraks time - date check						Transmitter power	
C	Brush recorder time - date check							

c. Operate the ground station for a 30-second printout of mode 1 channel 8.

d. Record the values of the performance parameters in the appropriate spaces in the performance parameter data sheet (Table 4-1).

e. Record six sequential values of frame 15 of channel 8, the galactic-noise sweep monitor.

f. Verify that the performance parameters are proper with respect to the spacecraft operational mode and exposure.

g. Correlate the performance parameter temperature measurements with the environmental temperature measurements, if applicable.

h. Correlate the telemetry performance parameter voltage and current measurements with the hardline measurements.

i. Verify that high-speed and low-speed sync comply with encoder specifications given in Unit B Data Sheet (Table 4-4).

4.3 UNIT B

The Unit B Data Sheet (Table 4-4) provides for the recording and evaluation of waveform measurements available from the spacecraft which are indicative of the proper operation of the spacecraft telemetry and recording system. The 320.18 cps (pin 3) applied to the tape recorder was measured for correlation with the 15.4-kc signal returned from the tape recorder during playback mode.

4.3.1 UNIT B PROCEDURE

4.3.1.1 Sync

a. Set up oscilloscope:

1. Channel A, dc input $\overline{A}$
2. Gain, 5v/cm
3. Channel B, dc input $\overline{L}$
4. Gain, 2v/cm
5. Trigger, negative external on $\overline{A}$

TABLE 4-4

UNIT B DATA SHEET

Spacecraft Condition:		Code:		By:	Date:	Time:
Pin	Description	Amplitude		Period	High-Speed Sync Tolerances (μsec)	Period (sec)
1	$\overline{A}$ HS Reset				Frame 0 194.14 - 198.06	
18	$\overline{L}$				Frame 1 221.08 - 221.11	
	Sync $\overline{A} \rightarrow \overline{L}$ (5ms)				Frame 2 157.16 - 160.33	
35	$\overline{T}$				Frame 3 221.08 - 221.11	
2	LS Environment	Data	Sync		Frame 4 132.01 - 134.68	
3	LS Video				Frame 5 221.08 - 221.11	
4	LS to T.R.				Frame 6 113.80 - 116.10	
15	LS Gate B				Frame 7 221.08 - 221.11	
19	HS Video				Frame 8 100.01 - 102.03	
20	XMTR Mod				Frame 9 221.08 - 221.11	
36	LS ÷ 48				Frame 10 89.20 - 91.00	
36	LS sync 10 P.A.				Frame 11 221.08 - 221.11	
24	Ø1				Frame 12 80.50 - 82.12	
41	Ø2				Frame 13 221.08 - 221.11	
	Ø shift (.1ms = 3.6°)				Frame 14 73.34 - 74.82	
	Symmetry				Frame 15 221.08 - 222.47	

Note: Encoder frequency tolerances given (μsec periods) are for ambient temperature only.
For temperature range of -10°C to +60°C sync (odd frames) maximum total deviation is 1 percent.
Even frames maximum total deviation is 1.5 percent.

6. Sweep, 1/2 sec/cm until scope circuit triggers
7. Sweep, 1 ms/cm
8. Mode, chopped

b. Measure and record sync delay of $\overline{L}$ from $\overline{A}$ (less than 5 ms).

c. Record period of $\overline{A}$ and $\overline{L}$ (connection by remote control).

d. Exercise encoder tuning fork kill (remote control).

e. Repeat steps (b) and (c) above.

f. Measure and record period of $\overline{T}$.

4.3.1.2 Phase One (Ø1) and Phase Two (Ø2) Measurements

a. Waveform and amplitude measurements

1. Test scope setup:

(a) Channel A, input-Ø1 (pin 24 on the monitor panel)

(b) Channel B, input-Ø2 (pin 41 on the monitor panel)

(c) Sweep, 1 ms/cm

(d) Amplitude 1.0 v/cm

(e) Trigger, internal

2. Observe whether waveforms are proper, and record amplitude.

b. Phase-difference measurement

PRECAUTION: Place input switch on counter (HP 523) on SEPARATE before connecting counter to Ø1 and Ø2, to preclude shorting the phases together.

1. Counter setup (HP 523CR):

(a) Counter input switch on SEPARATE

(b) Function selector on timer interval

(c) Trigger, slope

(1) Start, positive

(2) Stop, positive

(d) Time unit, μsec

(e) Trigger, level

(1) Start, positive (dc x 1) (0.5)

(2) Stop, positive (dc x 1) (0.5)

2. Connect:

   (a) Ø1 (pin 24) into start input

   (b) Ø2 (pin 41) into stop input

3. Record counter reading in unit B data sheet (Table 4-4).

4. Determine and record phase difference in unit B data sheet (Table 4-4).

   DISCUSSION: Since the frequency of Ø1 and Ø2 is 100 cps, their periods are 10 milliseconds. Thus 360 degrees are equal to 10 milliseconds. The normal phase relationship between Ø1 and Ø2 is 90 degrees.

5. Determine and record the symmetry of phase shift in the unit B data sheet (Table 4-4).

   (a) Interchange Ø1 and Ø2 input connections to counter.

       Ø2 to start input

       Ø1 to stop input

   (b) Trigger level

       (1) Start negative (dc x 1) (0.5)

       (2) Stop negative (dc x 1) (0.5)

   (c) Trigger slope

       (1) Start negative

       (2) Stop negative

6. Record counter reading in data sheet.

7. Determine phase difference and record.

TABLE 4-5

UNIT C DATA SHEET

Spacecraft Condition:		Code:	By: Date: Time:
Pin	Description	Value	
	Undervoltage level		Charging volts
22	Osc rate 1 a		Batt A current
	b		Batt B current
	c		R_1 volts
39	Osc rate 2 a		R_2 volts
	b		
	c		
45	15 VDC		Charging volts
8/42	15 VAC amp.		Batt A current
	freq.		Batt B current
22	Osc rate 1 SU		R_1 volts
	Spacecraft return		R_2 volts
	Load on B		
	Undervoltage on B		
	Sweep A to B		
	Sweep B to A		
22	Osc Rate 2, SU		

4.4 UNIT C

Unit C provides a check of the functions of undervoltage, battery switching, battery charging, and dumping. The unit C data sheet provides for appropriately recording the measured values (Table 4-5). When this procedure is used it is assumed that the spacecraft is connected and operating.

TABLE 4-6

UNIT C_1 DATA SHEET

Spacecraft Condition:					Code:			By:			Date:			Time:		
Time	Total Dumping I		Battery V		Battery I		Ext. Charge		+ 15V	15 VAC (8 & 42)		OSC Count		OSC Period		
	PP 6 µsec	PP 6 converted ma	A	B	A	B	Volts	Curr	Pin 45	Amp.	Freq.	1	2	1	2	

During an actual 18-hour undervoltage cycle, unit C_1 data sheet was used at least every one-quarter hour to provide for the recording and evaluation of the performance of operating parameters (Table 4-6).

4.4.1 UNIT C PROCEDURE

4.4.1.1 Check of Undervoltage and Battery Switching

a. Set up counter A (HP 523) on time interval to measure undervoltage oscillator rate 1 period.

b. Set up counter B (HP 523) on time interval to measure undervoltage rate 2 period.

c. Set up digital voltmeter (HP 405) and associated printer, if used, to monitor and record system voltage at monitor panel, pin 46.

d. Check calibration of digital voltmeter.

e. Set the current limit of external power supplies A and B to 3/4 amperes.

f. Set output voltages of external power supplies A and B to 14.0 v.

g. Set up S-52 control panel:

   1. Function switch on external A and B

   2. Undervoltage oscillator speedup off

h. Verify that spacecraft system is operating on external power supply A (load current indicated on external power supply A panel meter).

i. Reset all counters.

j. Monitor digital voltmeter displaying spacecraft system unregulated buss voltage to determine potential at which undervoltage occurs.

k. Slowly lower external power supply A output voltage in 0.1-v increments, dwelling about 5 seconds at each increment.

l. Observe and record spacecraft system voltage at the loss of full-load spacecraft system current.

m. Observe whether all undervoltage counters are operating.

n. Record average of three consecutive period measurements of each undervoltage oscillator rate.

o. Verify that all spacecraft system voltages are zero except +15 vdc and 15 vac.

p. Place undervoltage speedup of oscillator 1 ON. Record speedup period.

q. Observe and record that in about 30 minutes the spacecraft returns to normal operation, and all spacecraft system voltages are present and proper.

r. Check and record that the spacecraft system switched from external power supply A to B (spacecraft system current now displayed on external power supply B panel meter).

s. Return external power supply A to 14v.

t. Depress undervoltage reset to reset oscillator rate 2.

u. Repeat steps (i) through (o), using external power supply B, and check that the readings are the same as the recorded values.

4.4.1.2 Check of Battery Switching

a. Initial status: Spacecraft in undervoltage on external power supply A with load current indicated on panel meter.

b. Set external power supply B to 14v.

c. Return digital voltmeter + lead to pin 46 on monitor panel.

d. Slowly lower external power supply A output voltage.

e. Observe and record spacecraft system voltage at the change of system load current to external power supply B.

f. Record the switching potential from A to B. Switching potential is the difference between power supply A and B terminal voltages at the instant that power supply B assumes load.

g. Set external power supply A to 14v.

h. Slowly lower external power supply B output voltage.

i. Observe and record spacecraft system voltage at pin 46 on monitor panel at the change of system load current to external power supply A.

j. Record the switching potential from B to A.

k. Reset external power supply B to 14v.

4.4.1.3 Conclusion of Undervoltage Test

a. Set oscillator rate 2 in speedup.

b. Place undervoltage speedup of oscillator rate 2 ON.

c. Observe and record that in approximately 30 minutes the spacecraft returns to normal operation and that all spacecraft system voltages are present and proper.

d. Reset oscillator rate 1.

4.4.1.4 Dumping

PRECAUTION: This measurement is above spacecraft ground of common return; therefore, the digital voltmeter and the printer must be a completely isolated (floating) electrical system to prevent damage to spacecraft circuitry. The ground strap on the digital voltmeter shall NOT be connected to the negative input terminal. The associated printer, if used, shall be an isolated unit such as an HP 561 printer.

a. Set the current limit of external power supply A to 1 amp.

b. Connect the digital voltmeter to S-52 control panel jacks J11 (-) and J10 (+).

c. Place the spacecraft on internal batteries (S-52 control-panel function switch on A and B.)

d. Slowly raise the voltage of external power supply A until a current of 1 amp. is being supplied to the spacecraft system as noted on the charging current meter on S-52 control panel.

e. Measure and record:

   1. Solar paddle voltage
   2. Battery A charging current
   3. Battery B trickle charging current

4. PP6 (total dumping current) and convert from μsec to milliamps.

f. Verify that the sum of the spacecraft system current, the dumping currents, and the charging currents equal the spacecraft input current.

g. Repeat steps a. to f. at 2 amps.

h. Readjust A to the required input and record systems current.

i. Turn charging current to OFF position. Observe and record the system current and voltage.

j. Turn ON charging current if required.

4.5 UNIT D

Unit D provides an evaluation of the performance of the spacecraft tape recording system. Except for the recording of known inputs to experiments, for example, the measurements recorded in unit D data sheet are available only during the spacecraft playback mode (Table 4-7). Periodically, during continuous testing, measured inputs were applied through the experiments and correlated against their respective outputs recovered from telemetry during the spacecraft playback mode.

Spacecraft tape-recorder speed is checked by measuring the 320.83 cps (unit B, LS to TR) applied to the tape recorder and comparing it with the period of the 15.4 kc recovered during the playback mode.

TABLE 4-7

UNIT D DATA SHEET

Spacecraft Condition:		Code:	By:	Date:	Time:	
Pin	Description	Amplitude	Period	Type of Data Recorded		
	Manual command			Input	Playback Output	
	RF command					
	Cable configuration					
	Command rcvr. sens.					
6	Decoder IN					
40	Decoder OUT					
	Horn duration					
21	Tape recorder playback					
20	XMTR Mod					
	Osc period					
	15.4kc period					
	Playback time					
	Playback count					
	Recovered LS sync					
	Type of data recorded					

4.5.1 UNIT D PROCEDURE

a. Set up oscilloscope for measurements of:

- Decoder input
- Decoder output
- Tape recorder playback
- Transmitter modulation

b. Set up counter for measurement of oscillator period.

c. Set up stopwatch for playback time.

d. If RF command, obtain command receiver sensitivity.

e. Observe and record the indicated measurements appropriately in the unit D data sheet.

4.5.1.1 Command Receiver Sensitivity

a. Ensure that command transmitter attenuator is set at maximum attenuation (132 db).

b. Turn on primary ac power to command transmitter chassis.

c. Depress command button on command transmitter.

d. Observe reception of command, evidenced by break in telemetry signal followed by presence of 320-cps modulation for 2 seconds, and then the playback telemetry modulation.

e. Record the setting of the command transmitter attenuator.

> NOTE: The same RF cable interconnecting the the command transmitter and the command receiver is used for all measurements. Exceptions must be noted in the unit D data sheet.

f. If playback does not begin, reduce the command transmitter attenuator setting by 2 db. After a 2-minute delay, repeat steps from c. above.

4.6 UNIT E

Unit E consists of an evaluation of the performance of programmer #2 and the responses of the experiments to applied stimuli. The test cycle of unit E was every 4 to 6 hours.

The unit is divided into three test sequences with data collected as shown in Figures 4-1 and 4-2.

a. Programmer #2 in speedup or normal cycle; sunrise simulation, functional outputs monitored

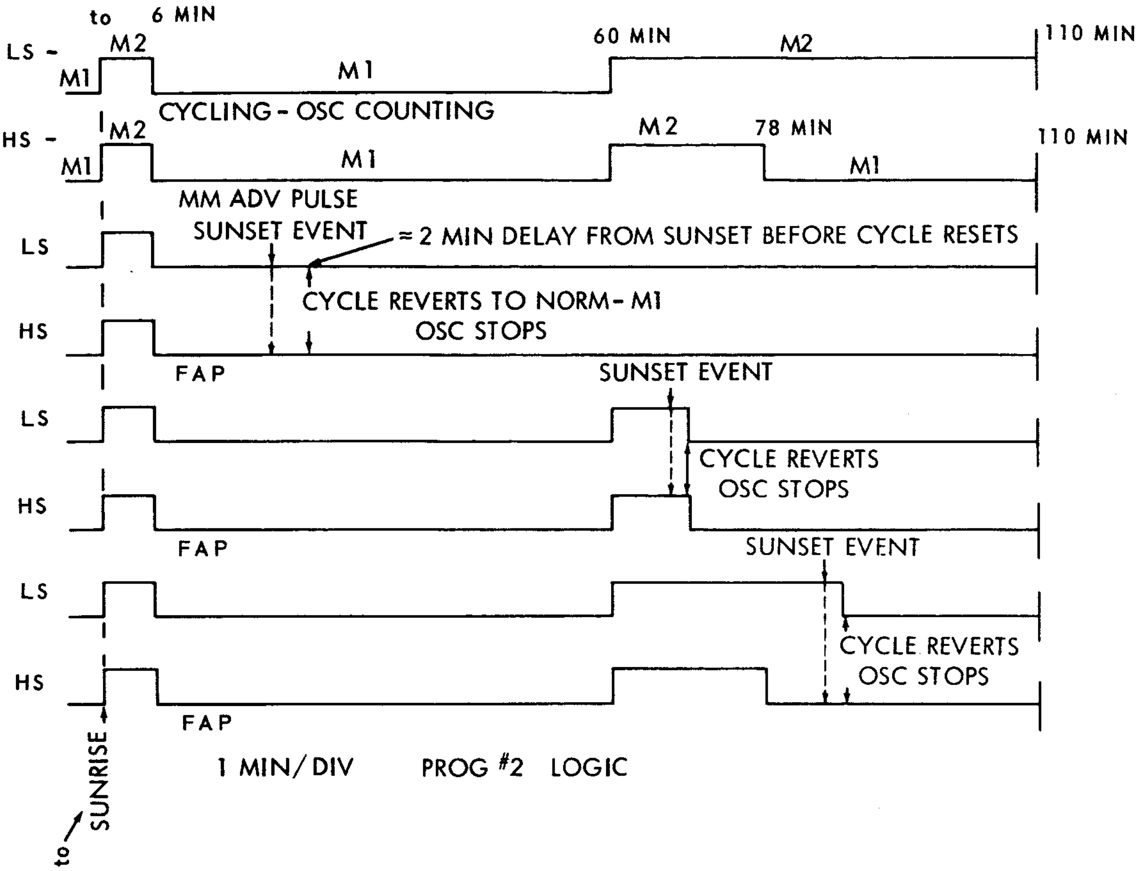
b. Programmer #2 in speedup cycle; sunrise simulation, functional outputs monitored; data storage and readout cycle via telemetry and hardline

c. Programmer #2 in normal 110-minute cycle; sunrise simulation, functional outputs monitored, and data storage and readout cycle via telemetry and hardline—The test sequences are modified to environmental conditions, e.g., no hardline monitoring during rotating tests, etc.

4.6.1 UNIT E PROCEDURE

Test a., unit E, verifies via hardline the operation of the high-speed and low-speed gates which determine the encoder's mode of operation, and the presence of the foil advance pulse to the micrometeoroid experiment. (See Figure 4-3, "Sequence of Operational Modes;" see also unit E data sheet, Table 4-8.)

Test b., performed with programmer #2 in speedup cycle, in addition to those parameters observed in test a. monitors the performance of the experiments as these are stimulated, the operation of the data storage and playback functions, and the telemetry format at the ground station. Data are transmitted by RF telemetry format to the ground station, and by hardline to adjacent instrumentation. Frequent comparisons of concurrent data samples obtained by hardline and telemetry help to establish a continuous indication of data-collection effectiveness (Figure 4-3).



M1 LS = GALACTIC NOISE ONLY ON TAPE
M1 HS = TM CONSISTS OF IROD-DROD-GN-PP.
M2 LS = OZONE
M2 LS = O_1 = OZONE MONITOR (O_1) ON CHAN 1-3-5-7-9-11-13-15
(O_2) ON CHAN 2-4-6-8-10-12
M2 HS = TM = CONSISTS OF ONLY OZONE SPECT ALL CHANNELS & FRAMES

Figure 4-3—Sequences of Operational Modes

Test c. is the same as test b., with programmer # 2 in normal cycle instead of speedup.

4.6.1.1 Micrometeorite Experiment Calibration

Micrometeorite experiment calibration is shown in unit E_1 data sheet (Table 4-9).

a. Equipment required:

1. Strip-chart recorder (Brush Mark II)

TABLE 4-8

UNIT E DATA SHEET

Spacecraft Condition:		Code:		By:		Date:	Time:
PIN	DESCRIPTION	LEVELS		EXCITER	RCVD	AMPLIFIER SELECTED	MECHANICAL ADVANCE
		HL	TM				
17	DROD-A-PRE						
	DROD-A-POST						
50	DROD-B-PRE						
	DROD-B-POST						
23	IROD -A						
	IROD - B						
5	FAP						

Remarks:

GALACTIC NOISE

PIN	DESCRIPTION	LEVELS			10 PER. AVG	EXCITER
		HL		TM		
		HS	LS			
48	1 Mc					
and	2 Mc					
31	Wideband					
16	Signal					
	Sweep					

Remarks:

Remarks: (Prog. #2)

OZONE

PIN	DESCRIPTION	LEVELS		10 PER. AVG	EXCITER
		HL	TM		
13	Spect A				
13	Spect B				
30	Oz				
47	Mon				

Remarks:

PROGRAMMER #2

PIN	DES.	AMP.	TIME OF OCCURRENCE		
			M1	M2	M1
	SR				
	SS				
34	HS				
15	LS				

2. S-52 telemetry ground station

3. Adjustable repetition rate pulse generator (S-52 ETB)

4. Micrometeorite interconnection panel

5. Portable sun gun used before and after tests

6. Interconnections

b. Connections:

1. Connect pulse generator B to IROD A input

2. Connect pulse generator C to DROD A preamplifier input

TABLE 4-9

MICROMETEORITE EXPERIMENT HARDLINE CALIBRATION, DATA SHEET E_1

Note: Inputs must be floating - All switches on panel in UP position

	IN	OUT	GAIN	TEMP.	PRESS.	TIME	DATE	REMARKS RUN #
IROD - A								
IROD - B								
DROD - A								
PRE								
POST								
DROD - B								
PRE								
POST								
IROD - A								
IROD - B								
DROD - A								
PRE								
POST								
DROD - B								
PRE								
POST								

3. Connect pulse generator D to DROD B preamplifier input
4. Connect pulse generator G to IROD B input
5. Connect pulse generator H to DROD A postamplifier input
6. Connect pulse generator J to DROD B postamplifier input

c. Adjust pulse generators:

1. B to 5 (10-second repetition rate)
2. C to 5 (6-second repetition rate)
3. D to 5 (8-second repetition rate)
4. G to 6 (9-second repetition rate)
5. H to 6 (7-second repetition rate)
6. J to 6 (11-second repetition rate)

d. Adjust output voltage of each pulse generator to provide an experiment output of 1.5 to 3.5 volts for duration of test.

NOTE: At selected periods during the test the amplitudes of the pulse generator will be varied to determine amplifier linearity.

e. Set up recorder.

1. Connect:

(a) Input to IROD A to channel 1

(b) Output of IROD A to channel 2

2. Sensitivity:

(a) Channel 1 to 0.2 volt/chart line

(b) Channel 2 to 0.5 volt/chart line

3. Chart speed 1 mm/sec

Operate recorder for at least 1 minute. Identify chart, date, time, gains, chart speed, exposure, and parameters.

Record hardline and telemetry data for each of the selected amplifiers of IROD's and DROD's.

The IROD experiment appears on all odd-numbered telemetry channels; DROD A is on channel 12 and DROD B is on channel 4.

Initiate a programmer #2 cycle to provide for a selection of the alternate micrometeorite amplifiers.

Observe and record advancement of detector foils. Record hardline and telemetry data for each of the selected amplifiers of IROD's and DROD's.

Calculate the gain of each amplifier.

Record data in Table 4-9.

4.6.1.2 Ozone Experiment Calibration

Ozone experiment calibration is shown in Table 4-10, Ozone Calibration Unit E_2.

a. Equipment required:

1. Digital voltmeter
2. Telemetry ground station (Westinghouse)
3. Ozone calibration box (ETB)

TABLE 4-10

OZONE CALIBRATION, UNIT E_2

Note: Run with charging OFF

			PMA			PMB			MON			OZ	
CONDITIONS	INPUT		13	TM		13	TM		47	PB TM		30	PB TM
Temperature													
Pressure													
Date													
Time													
Temperature													
Pressure													
Date													
Time													
Temperature													
Pressure													
Date													
Time													
Temperature													
Pressure													
Date													
Time													

4. Monitor panel

5. Interconnecting cables

b. Set up ozone calibration box.

1. Place function switch to position 5.

2. Adjust input voltage to -33v.

c. Check of ozone spectrometer PMA and PMB (See Table 4-11, unit E_3.)

1. Initiate spacecraft programmer #2 cycle.

2. Place selector switch (ozone calibration box) to PMA.

3. Place function switch to position 4.

4. Measure and record:

   (a) Calibration box input voltage (BNC top of calibration box)

   (b) Voltage pin #13 (monitor panel)

   (c) Period (μsec) of telemetry data on channel 1

5. Repeat procedures 2 through 4 for each of the remaining four function switch positions 3, 2, 1, and OFF.

6. Repeat procedures 2 through 5 for selector switch positions PMB.

NOTE: As shown in Figure 4-3, the ozone experiment data is present on telemetry for 6 minutes; however, mode 2 returns in 54 minutes for an additional 18 minutes, permitting time to complete the "calibration."

TABLE 4-11

OZONE SPECTROPHOTOMETER CALIBRATION, UNIT E_3

PROCEDURE: Take voltage reading before turning on light. Turn on desired light for 7 minutes charging current OFF.

Date Time		Pin No.	Light Off Voltage	Light On Voltage
________	Broadband monitor	47	________	________
________	Broadband ozone	30	________	________
________	Spectrometer A	13	________	________
________	Spectrometer B	13	________	________
________	Broadband monitor	47	________	________
________	Broadband ozone	30	________	________
________	Spectrometer A	13	________	________
________	Spectrometer B	13	________	________
________	Broadband monitor	47	________	________
________	Broadband ozone	30	________	________
________	Spectrometer A	13	________	________
________	Spectrometer B	13	________	________
________	Broadband monitor	47	________	________
________	Broadband ozone	30	________	________
________	Spectrometer A	13	________	________
________	Spectrometer B	13	________	________

d. Check of monitor and ozone.

NOTE: The telemetry output of these detectors is provided only in the spacecraft playback mode. Therefore, the low speed data will be measured and recorded, in μsec period of subcarrier-oscillator frequency, before it is applied to the spacecraft tape recorder for comparison with telemetry playback data.

e. Set up oscilloscope.

1. Connect:

   (a) Channel A input to monitor panel pin 36 (LS before divided by 48)

   (b) Vertical output of oscilloscope to counter (HP 523 CR) input

   (c) External scope trigger to decommutator sync output

2. Place programmer #2 in HOLD until completion of this recording.

3. Select ozone

4. Function switch to 4

5. Measure and record:

   (a) Calibration box input voltage

   (b) Voltage at pin 30

   (c) Period of ozone subcarrier oscillator

6. Repeat steps 3, 4, and 5, for each selected position 3, 2, 1, and OFF, dwelling 10 minutes at each position to obtain recording time.

7. Repeat steps 3 through 5 for monitor, measuring output voltage at pin 47.

8. Terminate programmer #2 cycle.

9. Command spacecraft playback mode.

10. Record telemetry on ground-station tape recorder.

11. Recover, record, and correlate telemetry data with applied values.

4.6.1.3 Galactic-Noise Experiment Calibration

Table 4-12 shows galactic-noise experiment calibration data sheet, Unit E_4.

a. Equipment required:

1. Signal generator (HP 606A)
2. Exciter stub antenna (ETB) mounted adjacent to spacecraft
3. Interconnecting coax cable
4. Automatic oscillograph recording system

b. Check of galactic receiver response

1. Operate automatic oscillograph recording system to obtain chart as shown in Figure 4-4.
2. Identify chart.
3. Record at least 2 cycles of galactic-noise responses unexcited.
4. Record indicated parameter measurements in unit E_4.
5. Record at least 2 cycles of galactic-noise response for each of the following excitation frequencies from the signal generator:

kc	Mc	Mc
750	1.0	2
850	1.2	2.2
	1.4	2.5
	1.6	2.7
	1.8	3.0

TABLE 4-12

GALACTIC-NOISE EXPERIMENT CALIBRATION DATA SHEET, UNIT E_4

Exciter Frequency	Exciter Amplitude	Response Amplitude	Sweep Amplitude	Telemetry	
				High Speed	Sweep
		Hardline pin 48		Amplitude (μsec)	Amplitude (μsec)
750 kc					
850 kc					
1 Mc					
1.2					
1.4					
1.6					
1.8					
2.0					
2.2					
2.5					
2.7					
3.0					

6. Adjust the signal generator to 3 millivolts (-40 db) for each measurement.

7. Record sweep voltage versus excitation frequency and signal amplitude.

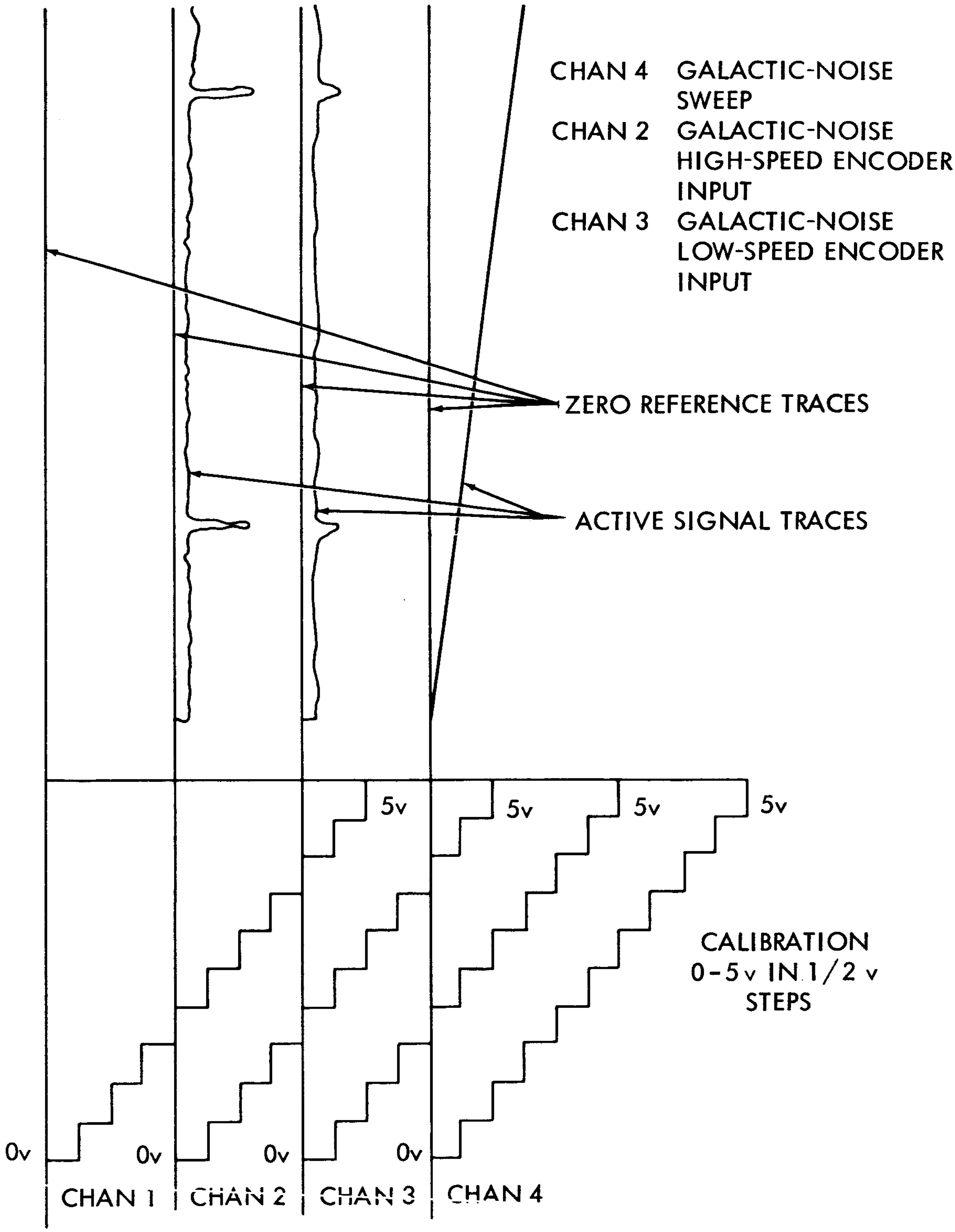


Figure 4-4—Sample Strip Chart Using Programmable Strip-Chart Recording System

5. PERFORMANCE-PARAMETER CALIBRATIONS AND TEST RESULTS

Table 5-1 lists spacecraft performance parameters which are present on the S-52 mode 1 telemetry format. Table 5-2, a conversion table, is provided for relating the normal displayed data in μsecs period to the more convenient units of frequency and voltage.

TABLE 5-1

PERFORMANCE PARAMETERS FOR S-52 FLIGHT 1

PP0	Broadband ozone (monitor)
PP1	Broadband ozone (ozone cell)
PP2	Ozone spectrometer temperature (PMA)
PP3	EHT
PP4	+ 15 v
PP5	Tape-recorder temperature
PP6	Total dumping current
PP7	Unregulated buss (+ 11.5v to + 16.5v)
PP8	Galactic-noise reel (+ 12v)
PP9	Solar paddle current
PP10	Battery current [charging or discharging, depending upon PP9]
PP11	Battery A temperature
PP12	Solar paddle #4 temperature
PP13	Upper dome temperature
PP14	Lower skin temperature
PP15	Galactic-noise sweep monitor

TABLE 5-2

CONVERSIONS

Volts	kc	Period (μ sec)	Volts	kc	Period (μ sec)	Volts	kc	Period (μ sec)	Volts	kc	Period (μ sec)
5.00	5.0	200.0	3.70	7.6	131.5	2.45	10.1	99.0	1.20	12.6	79.3
4.95	5.1	196.1	3.65	7.7	129.8	2.40	10.2	98.0	1.15	12.7	78.7
4.90	5.2	192.3	3.60	7.8	128.2	2.35	10.3	97.0	1.10	12.8	78.1
4.85	5.3	188.7	3.55	7.9	126.4	2.30	10.4	96.1	1.05	12.9	77.5
4.80	5.4	185.1	3.50	8.0	125.0	2.25	10.5	95.2	1.00	13.0	76.9
4.75	5.5	181.8	3.45	8.1	123.4	2.20	10.6	94.3	0.95	13.1	76.3
4.70	5.6	178.5	3.40	8.2	121.9	2.15	10.7	93.4	0.90	13.2	75.7
4.65	5.7	175.4	3.35	8.3	120.4	2.10	10.8	92.5	0.85	13.3	75.1
4.60	5.8	172.4	3.30	8.4	119.0	2.05	10.9	91.7	0.80	13.4	74.6
4.55	5.9	169.5	3.25	8.5	117.6	2.00	11.0	90.9	0.75	13.5	74.0
4.50	6.0	166.6	3.20	8.6	116.2	1.95	11.1	90.1	0.70	13.6	73.5
4.45	6.1	163.4	3.15	8.7	114.9	1.90	11.2	89.2	0.65	13.7	72.9
4.40	6.2	161.2	3.10	8.8	113.6	1.85	11.3	88.4	0.60	13.8	72.4
4.35	6.3	158.7	3.05	8.9	112.3	1.80	11.4	87.7	0.55	13.9	71.9
4.30	6.4	156.2	3.00	9.0	111.1	1.75	11.5	86.9	0.50	14.0	71.4
4.25	6.5	153.8	2.95	9.1	109.8	1.70	11.6	86.2	0.45	14.1	70.9
4.20	6.6	151.5	2.90	9.2	108.6	1.65	11.7	85.4	0.40	14.2	70.4
4.15	6.7	149.2	2.85	9.3	107.4	1.60	11.8	84.7	0.35	14.3	69.9
4.10	6.8	147.0	2.80	9.4	106.3	1.55	11.9	84.0	0.30	14.4	69.4
4.05	6.9	144.9	2.75	9.5	105.2	1.50	12.0	83.3	0.25	14.5	68.9
4.00	7.0	142.8	2.70	9.6	104.1	1.45	12.1	82.6	0.20	14.6	68.4
3.95	7.1	140.8	2.65	9.7	103.0	1.40	12.2	81.9	0.15	14.7	67.9
3.90	7.2	138.8	2.60	9.8	102.0	1.35	12.3	81.2	0.10	14.8	67.5
3.85	7.3	136.9	2.55	9.9	101.0	1.30	12.4	80.6	0.05	14.9	67.0
3.80	7.4	135.1	2.50	10.0	100.0	1.25	12.5	80.0	0.00	15.0	66.6
3.75	7.5	133.3									

Three-point calibration curves of spacecraft temperature sensors PP0, PP1, PP2, PP5, PP11, PP12, PP13, and PP14 (Figure 5-1 through 5-8) were established, using the first valid telemetry data after initial spacecraft turn-on subsequent to arriving at environmental temperature stabilization. Temperature stabilization is defined as a gradient on all environmental sensors of less than 1/2°C/hour about the stabilization temperature. Correlation of the spacecraft sensor temperatures with environmental sensors showed agreement within a few percent throughout the temperature excursions.

Figures 5-9 through 5-12 show the performance of PP6, PP7, PP9, PP10 at the three temperature-stabilization points. Note: when PP9 is at

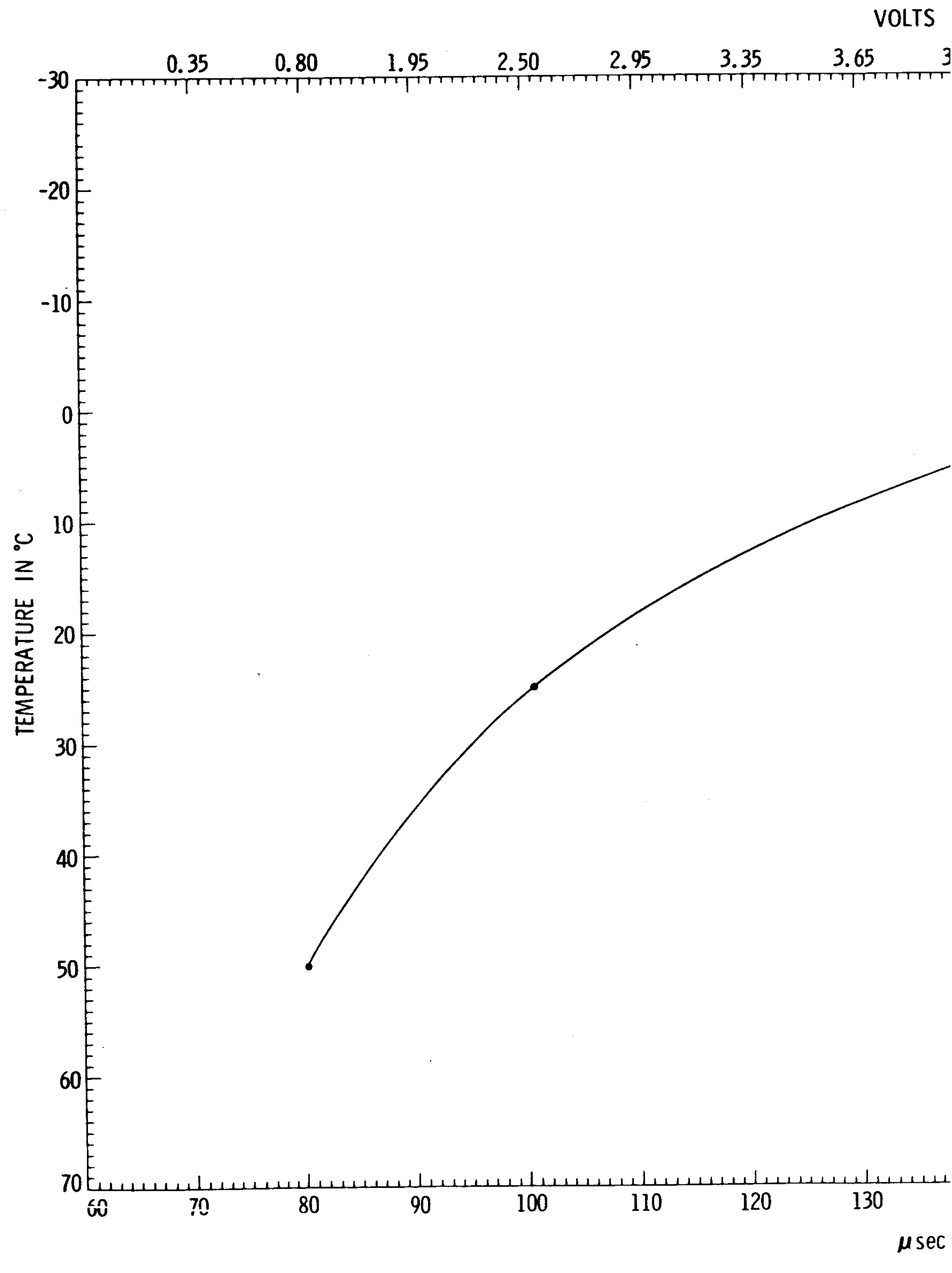
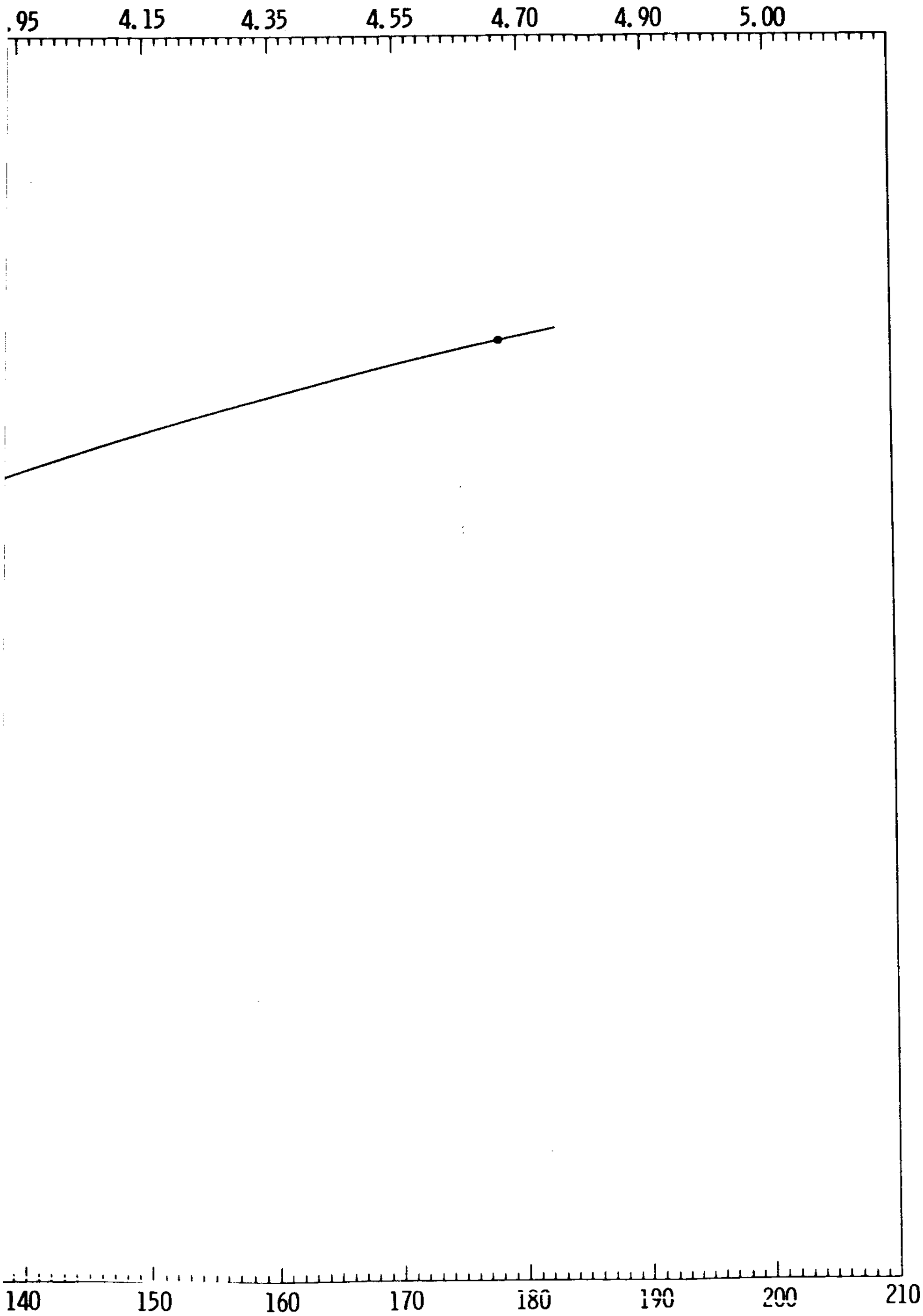


Figure 5-1—PPO (Ozone Monitor Temp
in Microseconds with Respec



ɘrature) Telemetry (10-Period Average)
: to Temperature and Voltage

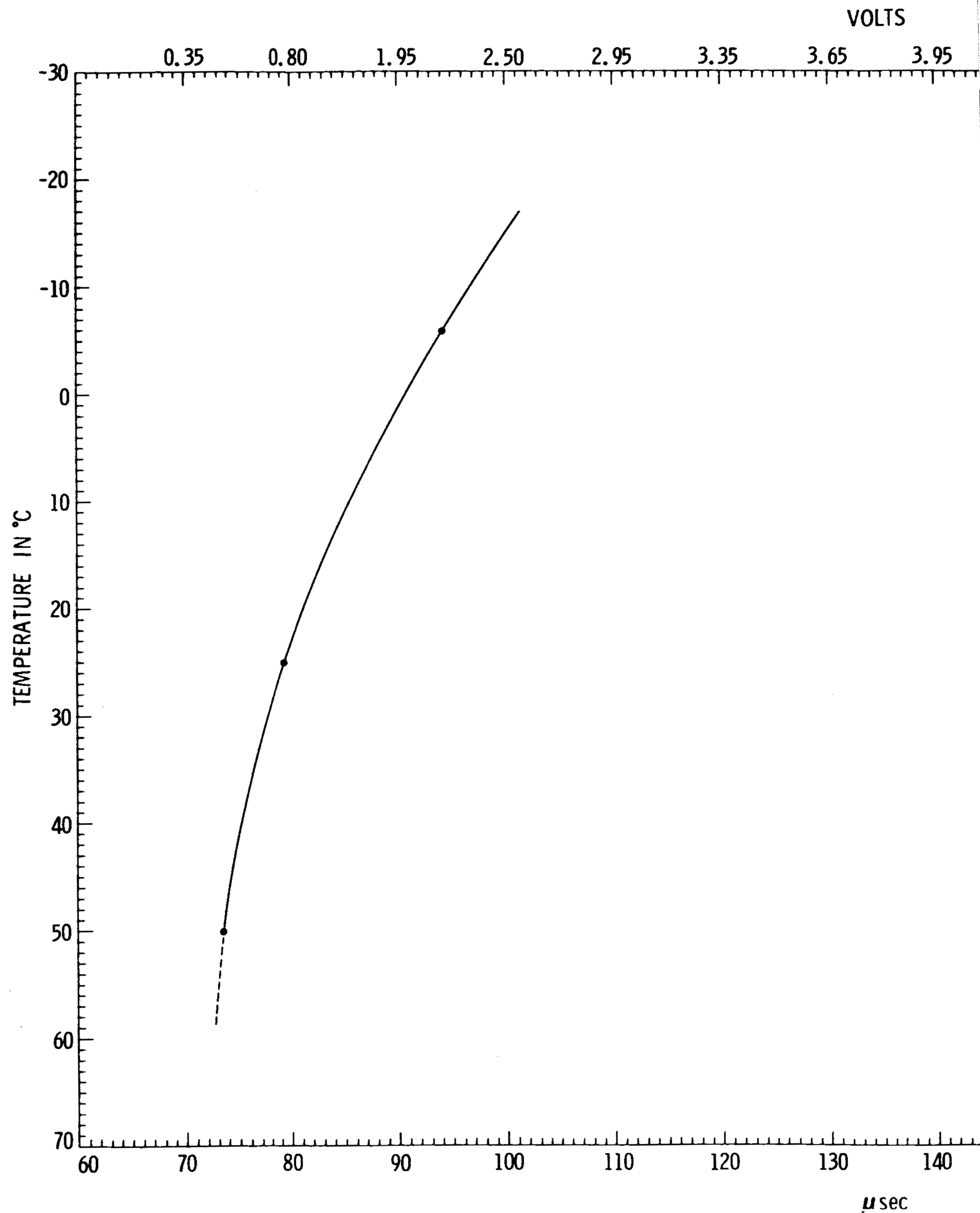
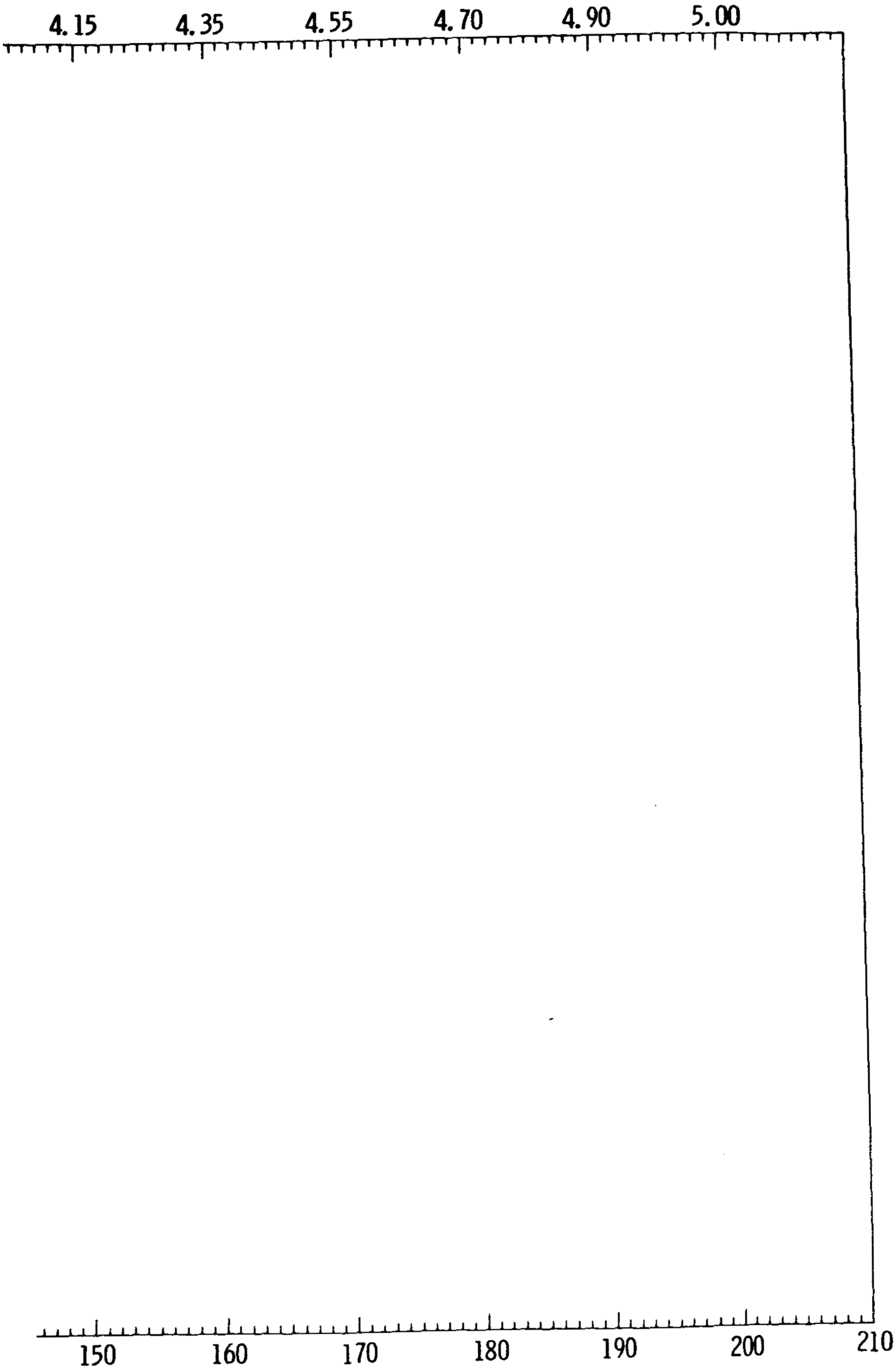


Figure 5-2—PP1 (Ozone Temperature) Telemetry
seconds with Respect to Temperatu



10-Period Average) in Micro-
e and Voltage

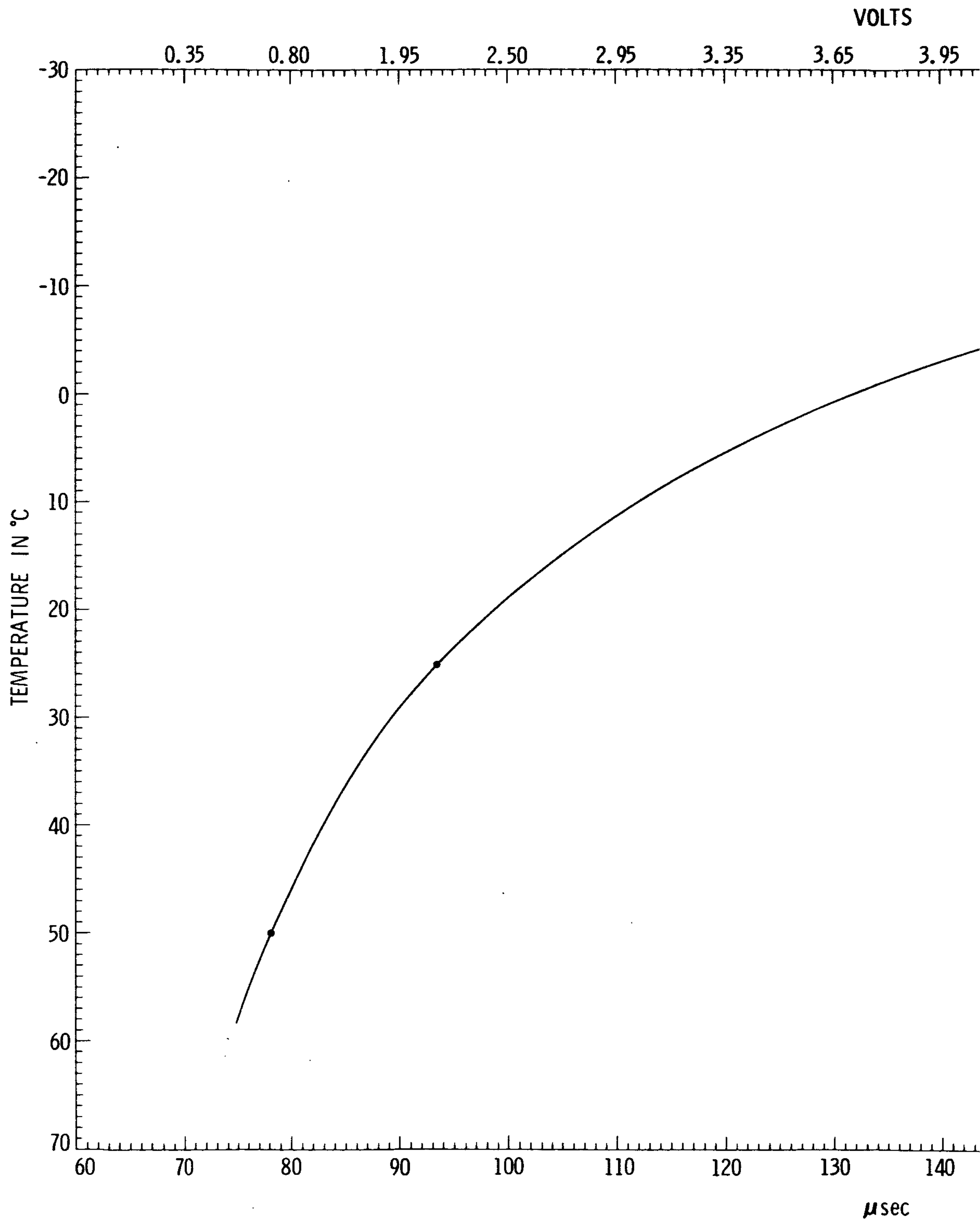
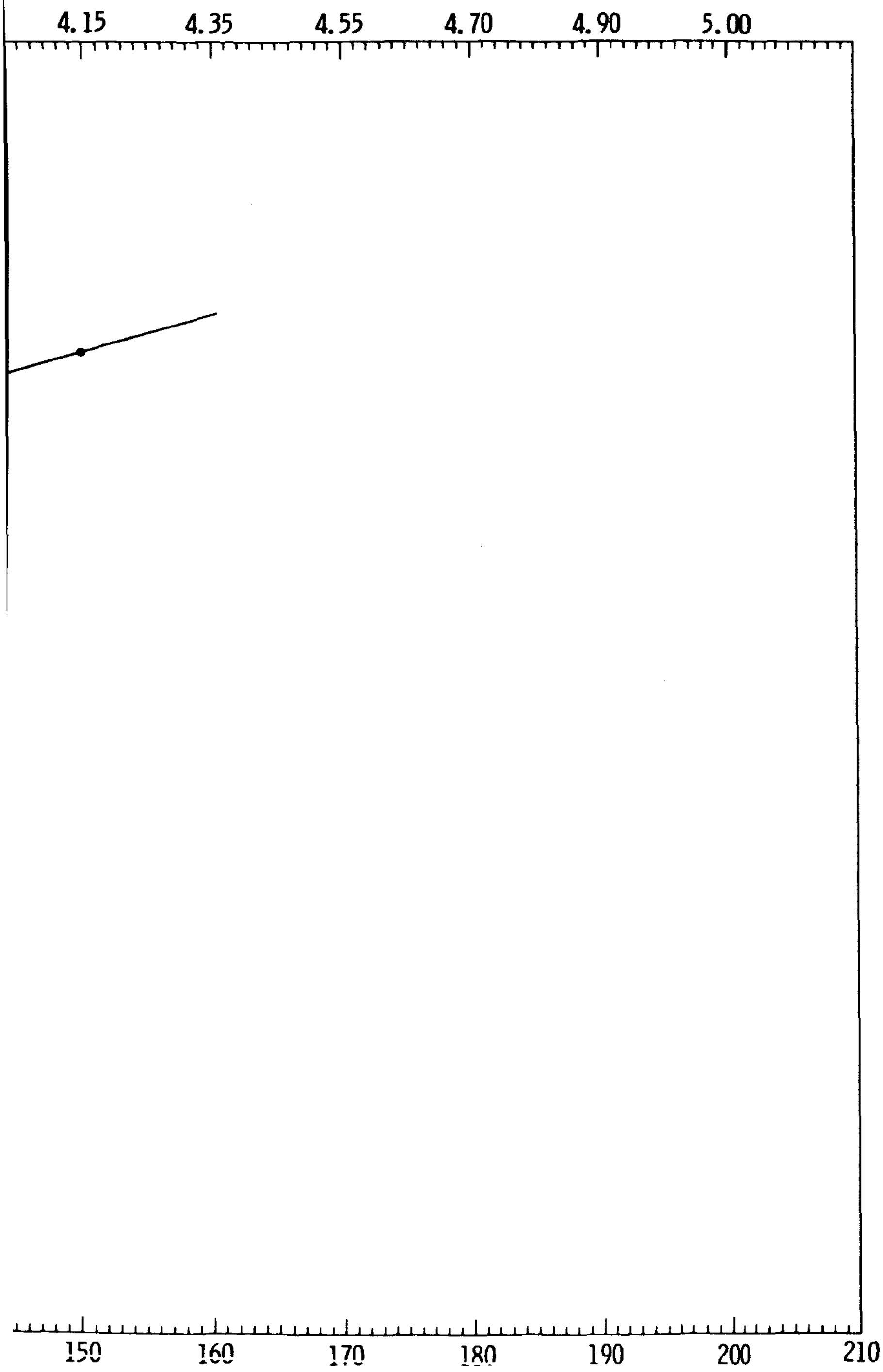


Figure 5-3—PP2 (Spectrometer A Temperatu
in Microseconds with Respect to T



:) Telemetry (10-Period Average)
mperature and Voltage

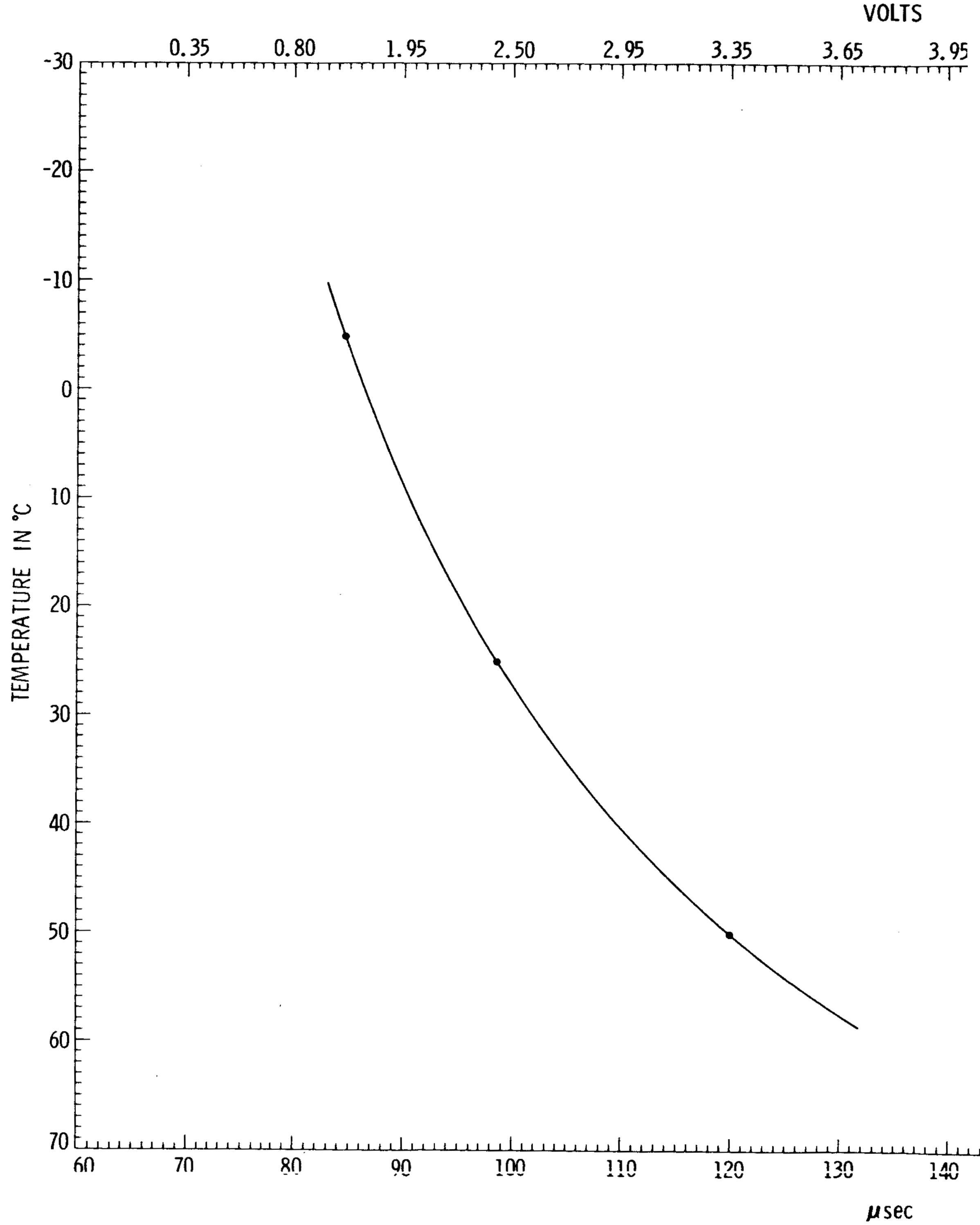
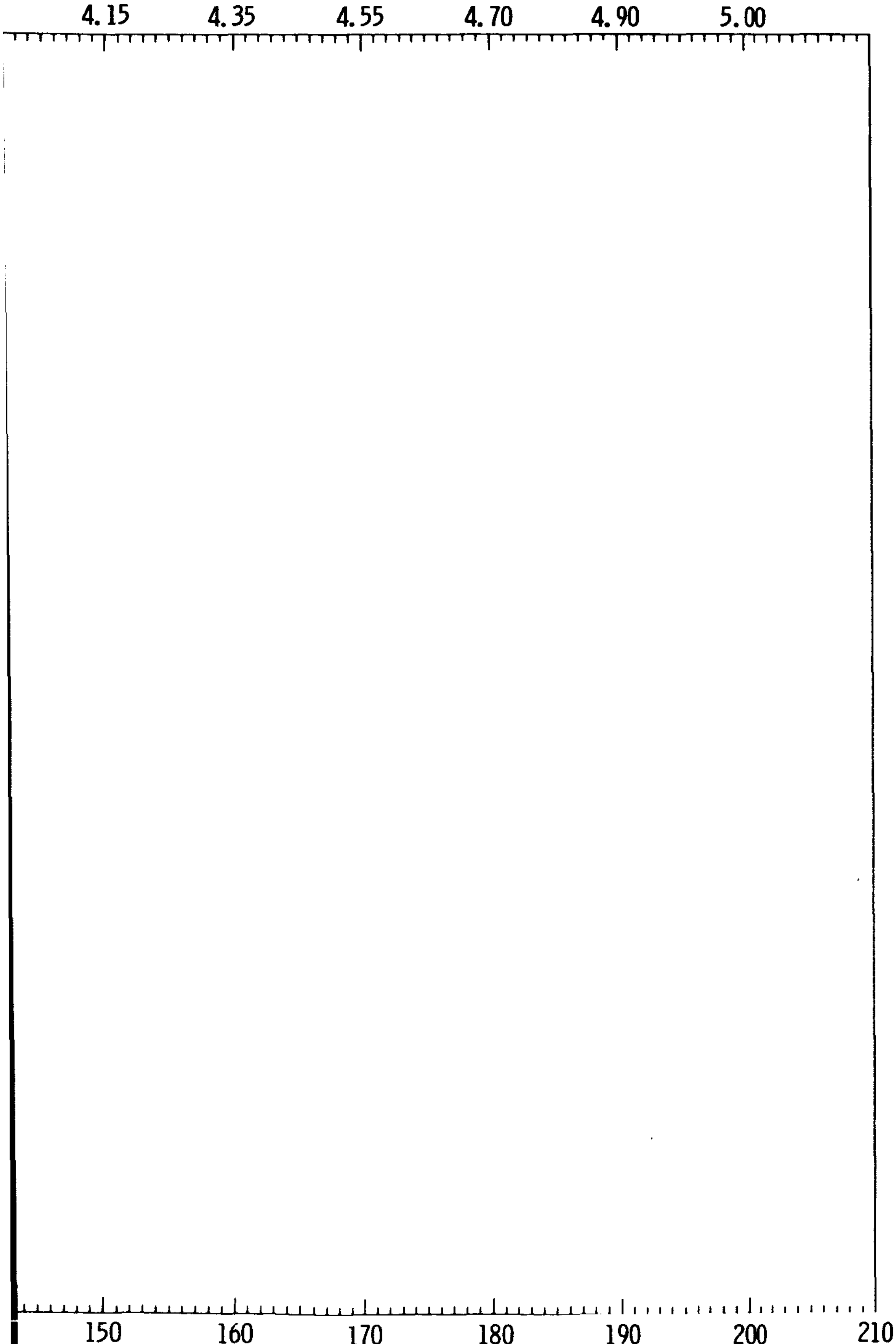


Figure 5-4—PP5 (Tape Recorder Temperature) Tel
in Microseconds with Respect to Temper



emetry (10-Period Average)
ature and Voltage

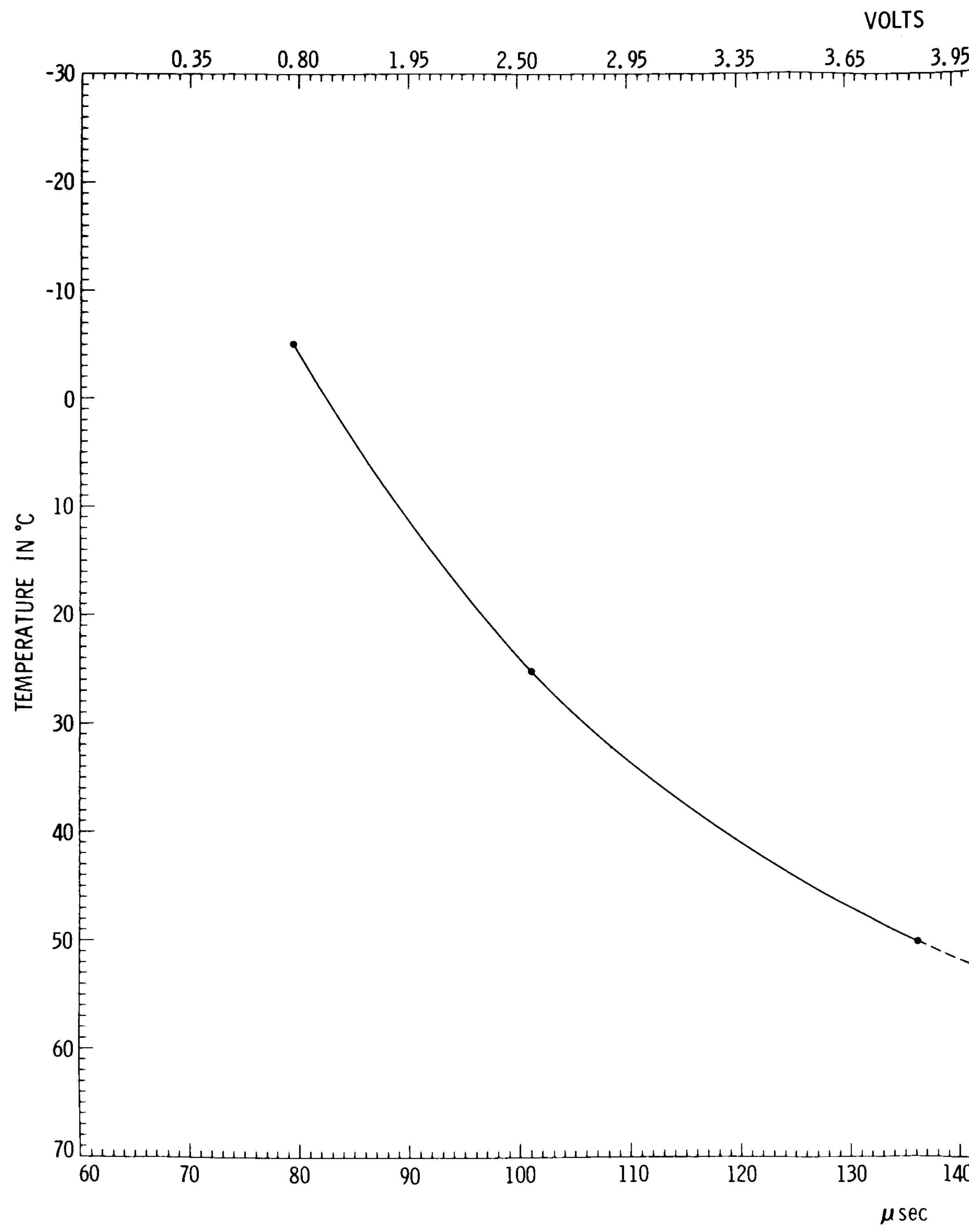
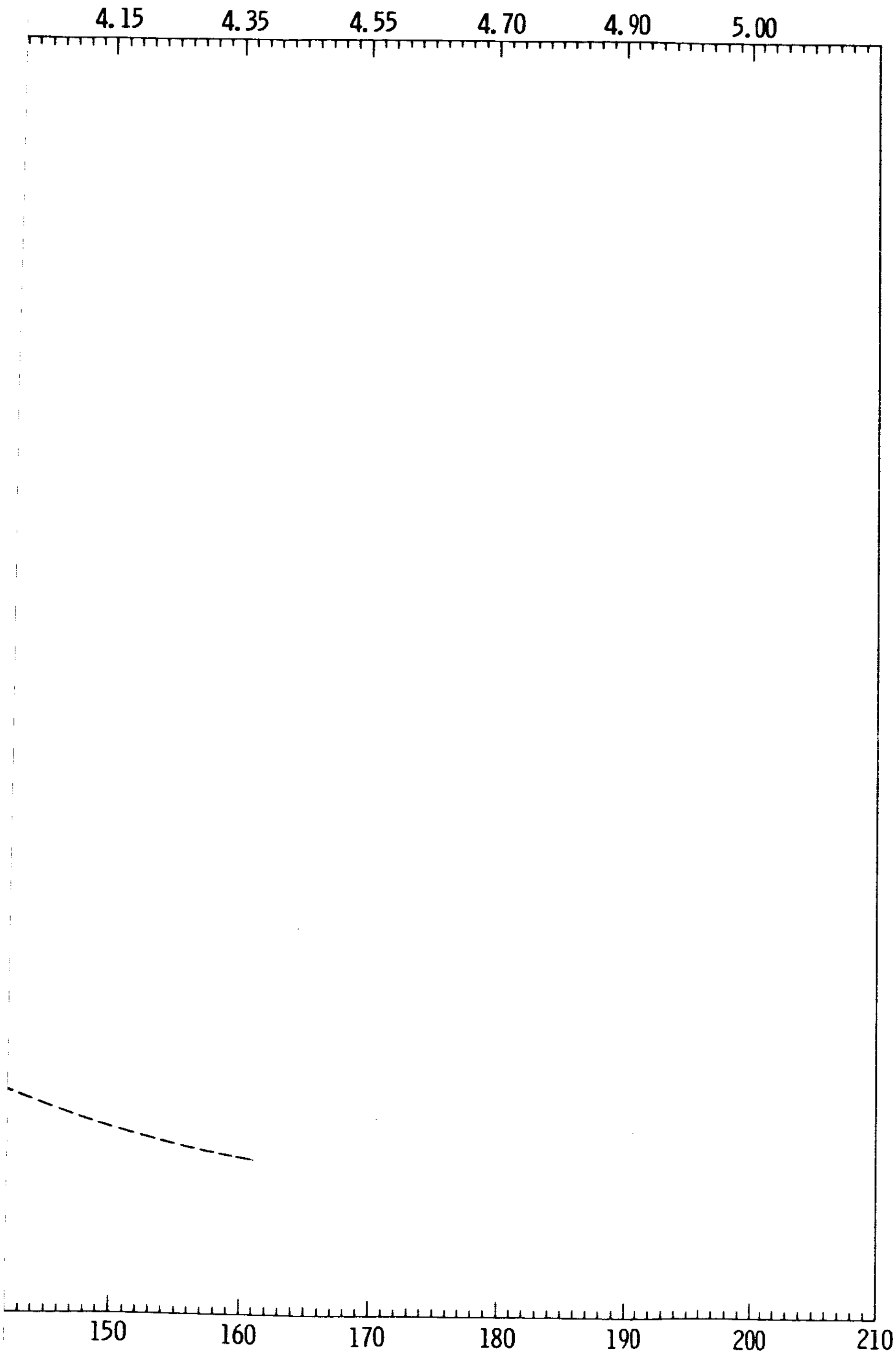


Figure 5-5—PP11 (Battery A Temperature) Te
Microseconds with Respect to Tem



emetry (10-Period Average) in
erature and Voltage

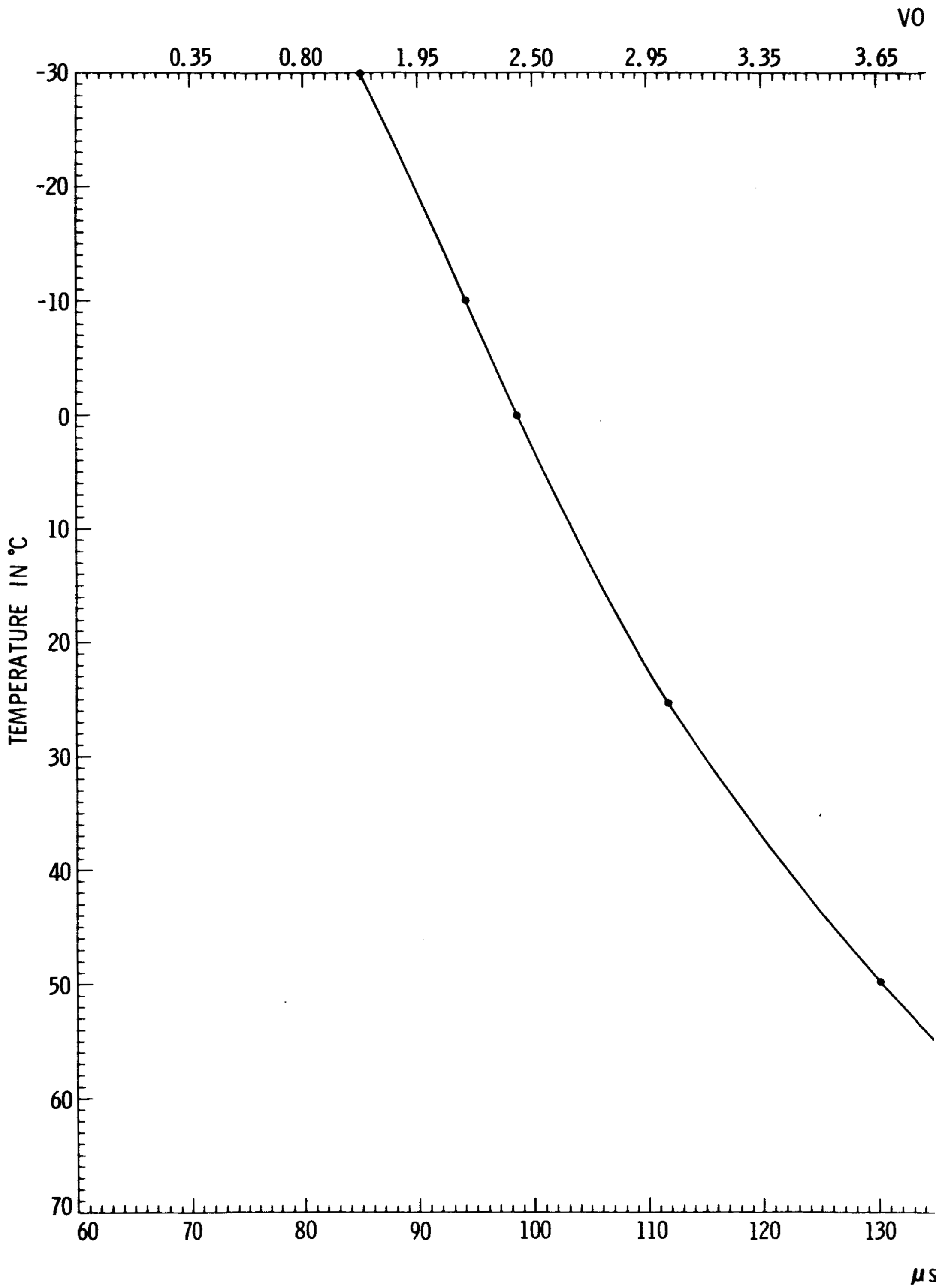
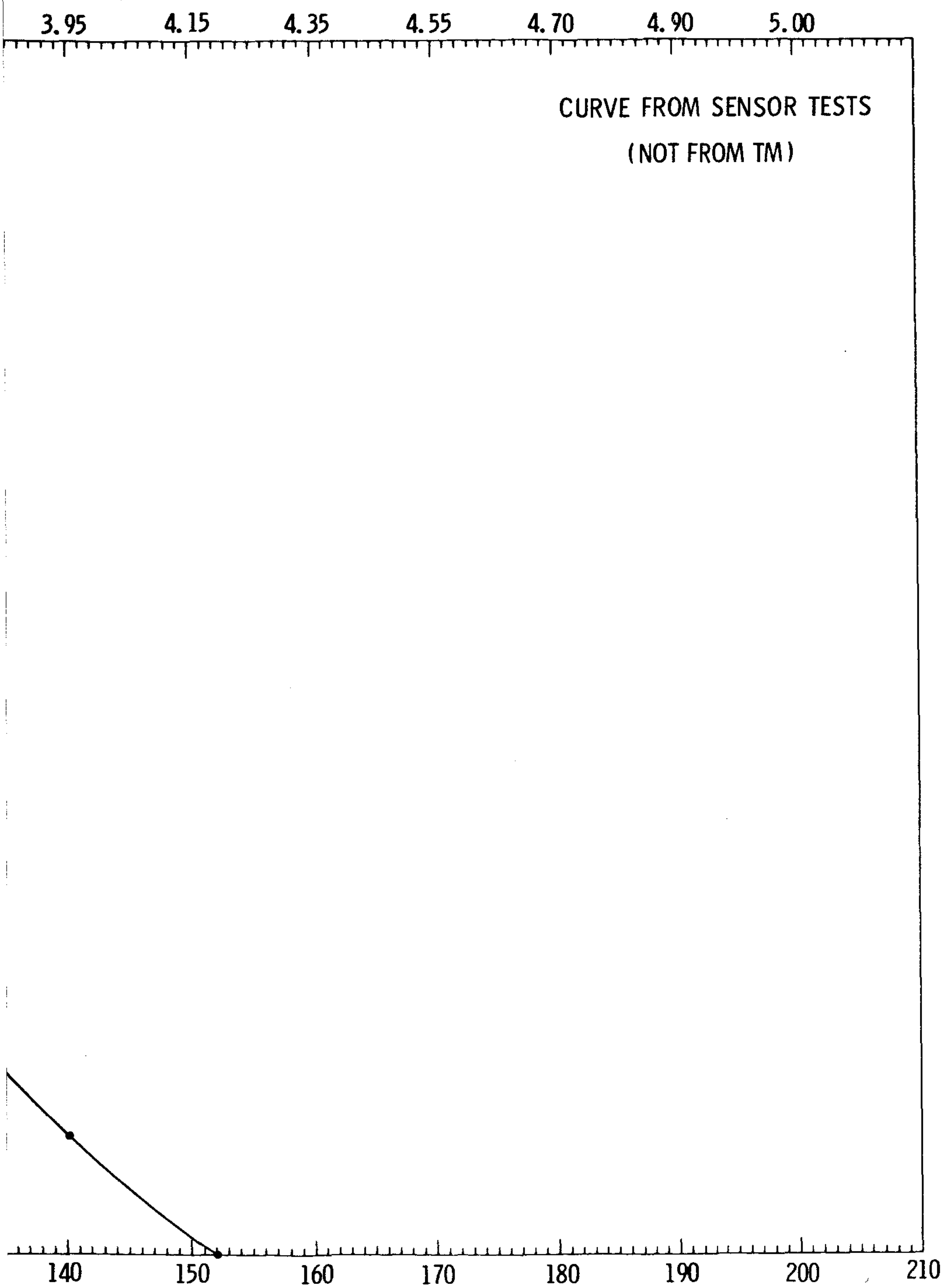


Figure 5-6—PP-12 (Paddle-A
with Respect to Tem

LTS



ec

rm Temperature) in Microseconds
perature and Voltage

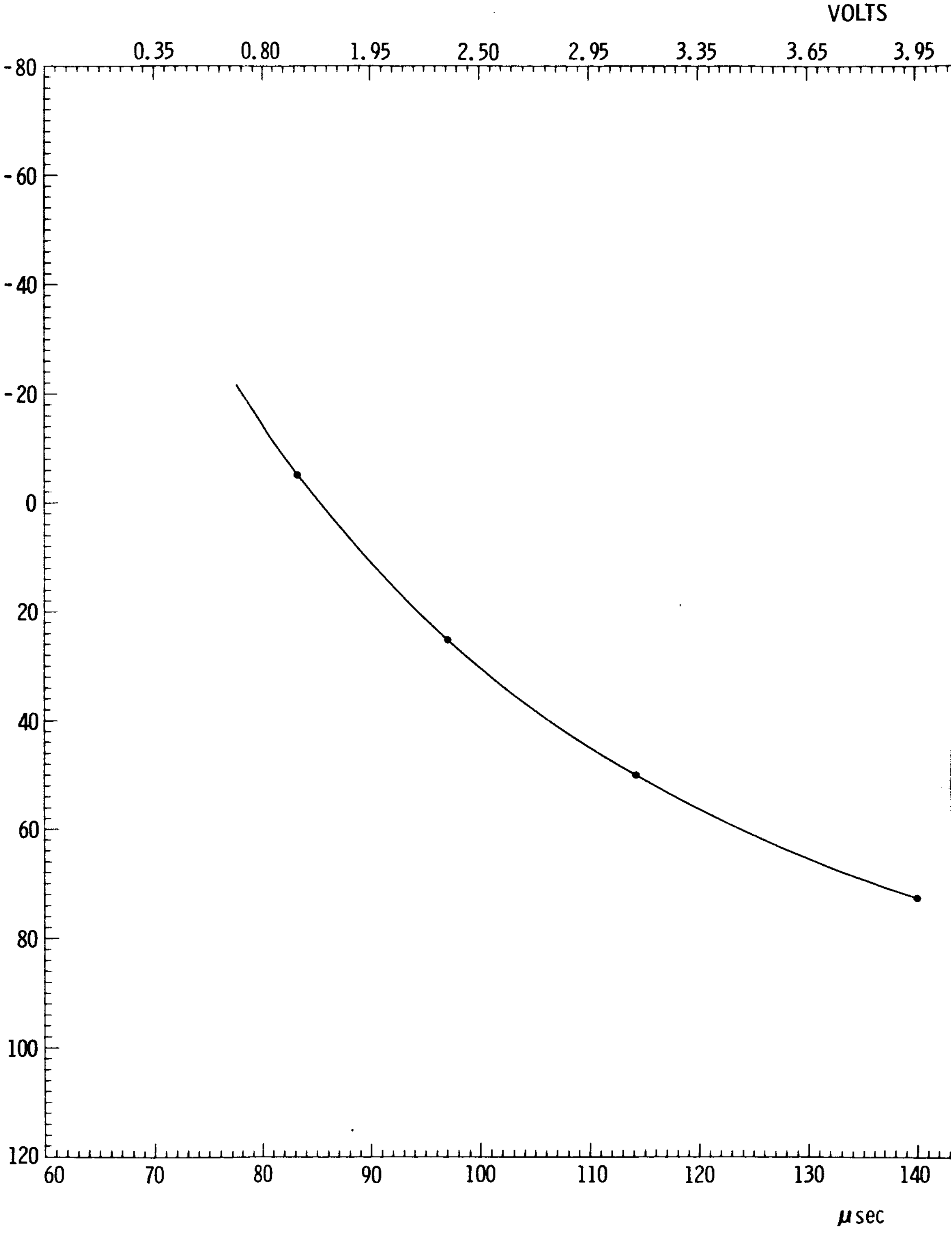
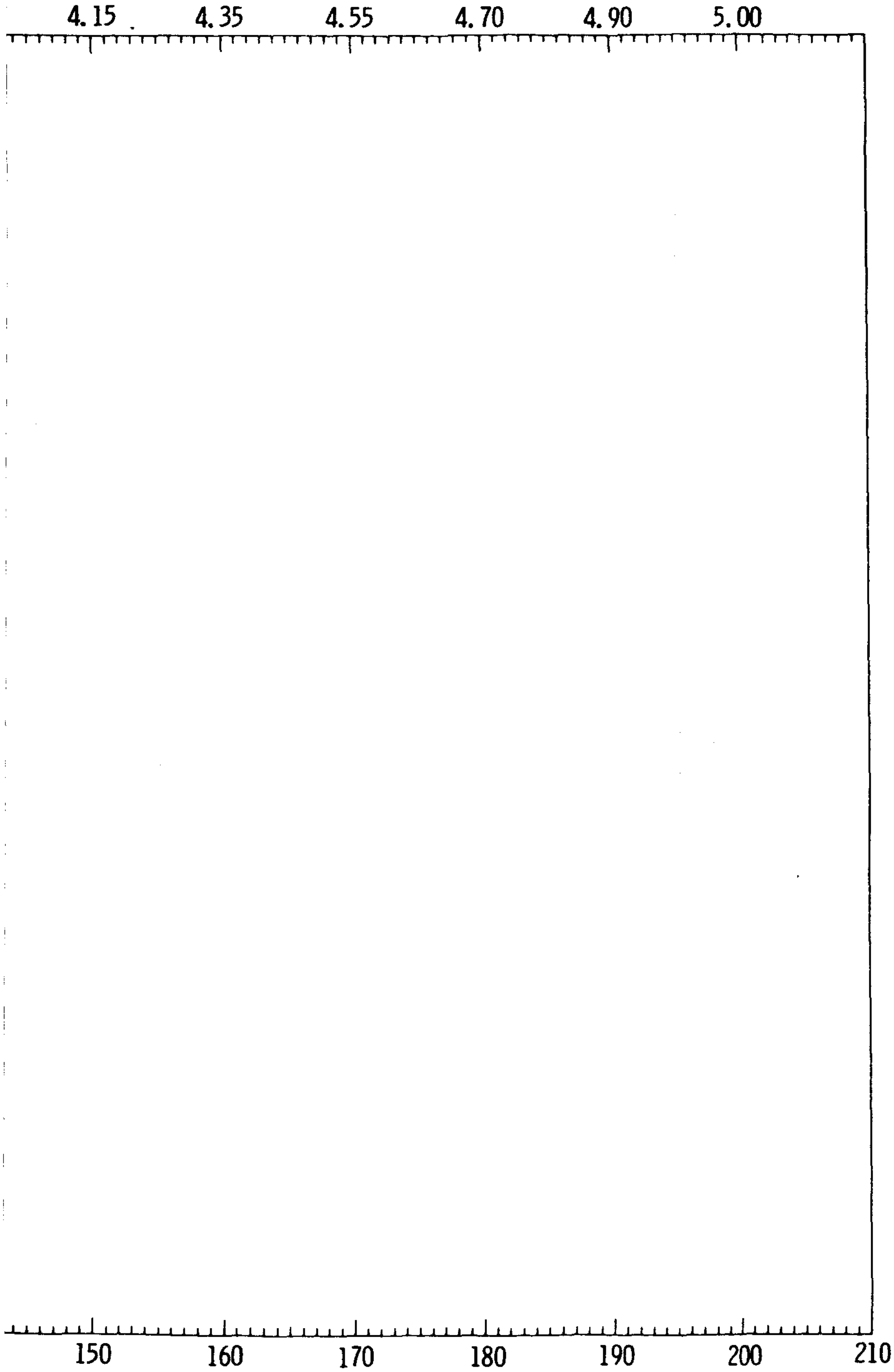


Figure 5-7—PP13 (Upper Dome Temperature Telen
Average) in Microseconds with Respect to



ıetry Curve) Telemetry (10-Period
Temperature and Voltage

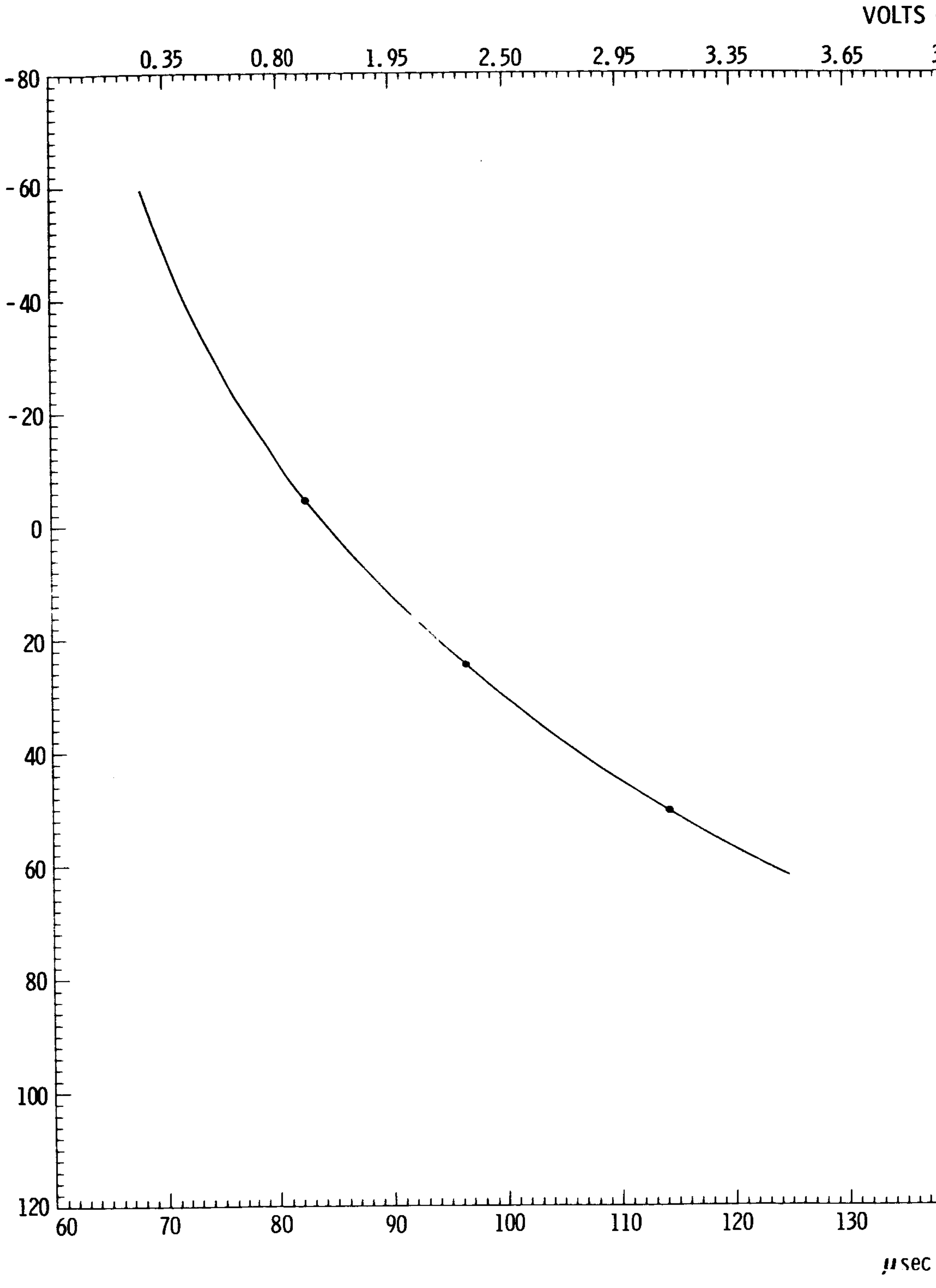
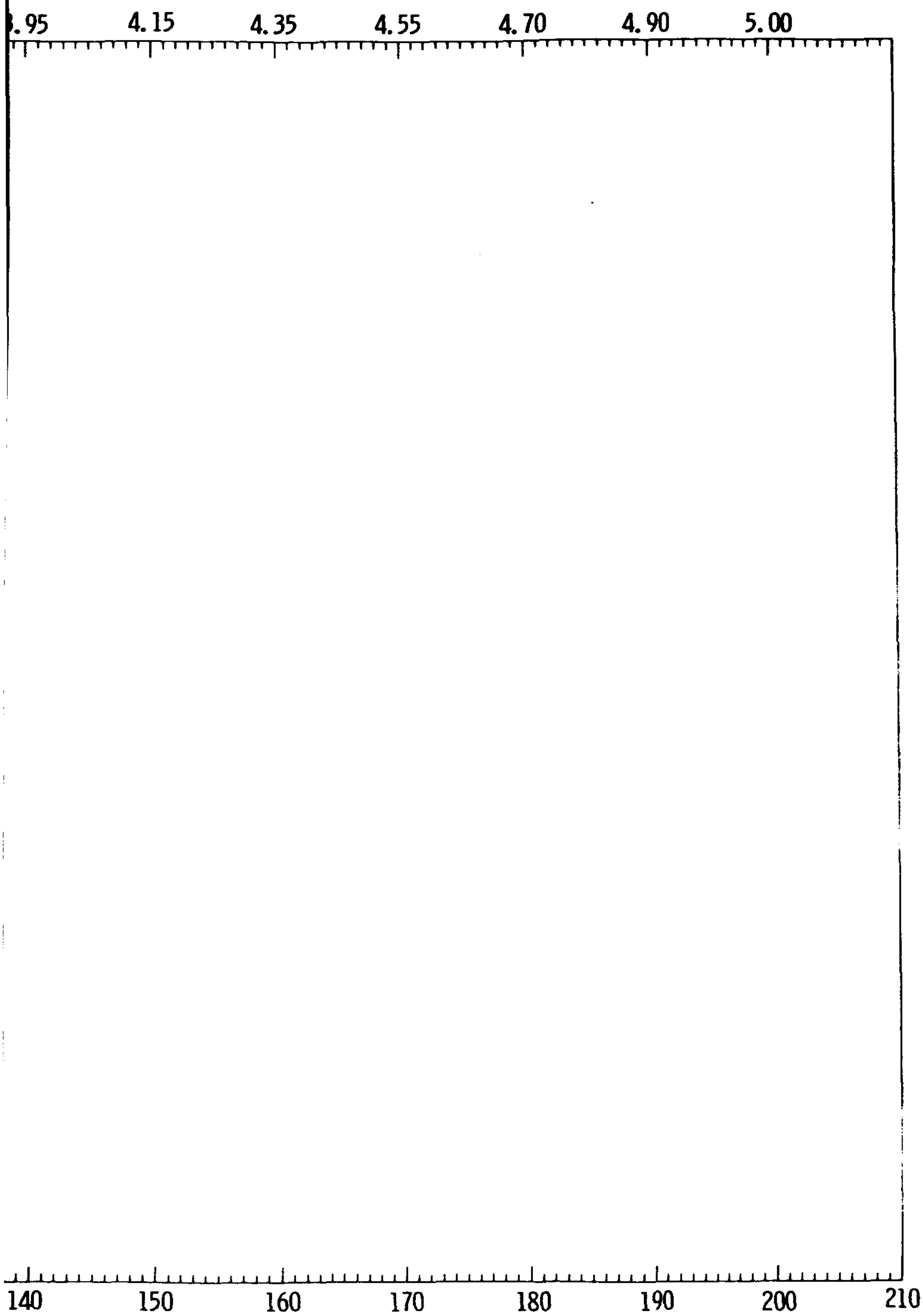


Figure 5-8—PP14 (Lower Skin Temperature
Average) in Microseconds with Resp



Telemetry Curve) Telemetry (10-Period
ct to Temperature and Voltage

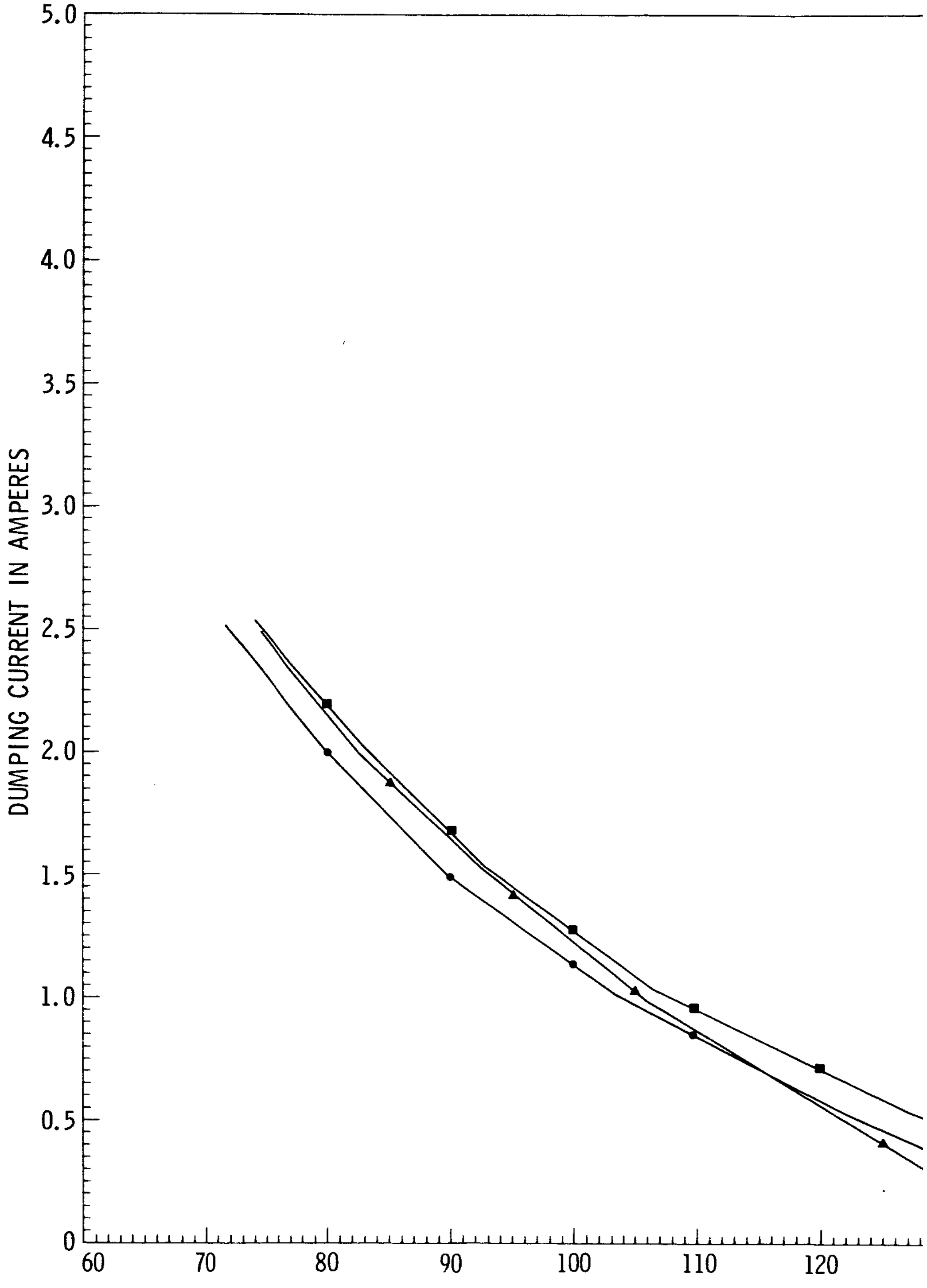
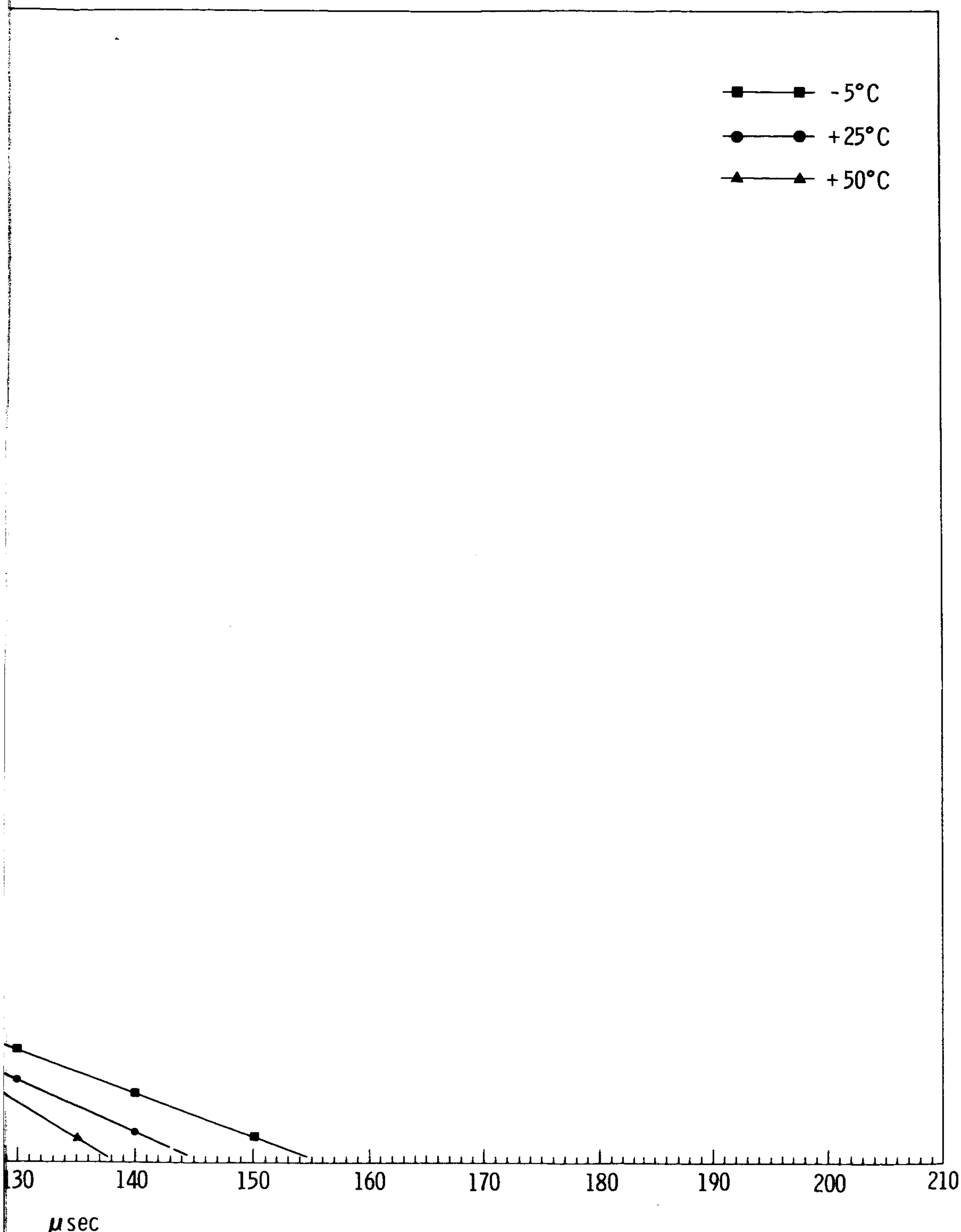


Figure 5-9—PP6 (Total Dumping
seconds



Current) Telemetry (10-Period Average) in Micro-
with Respect to Temperature

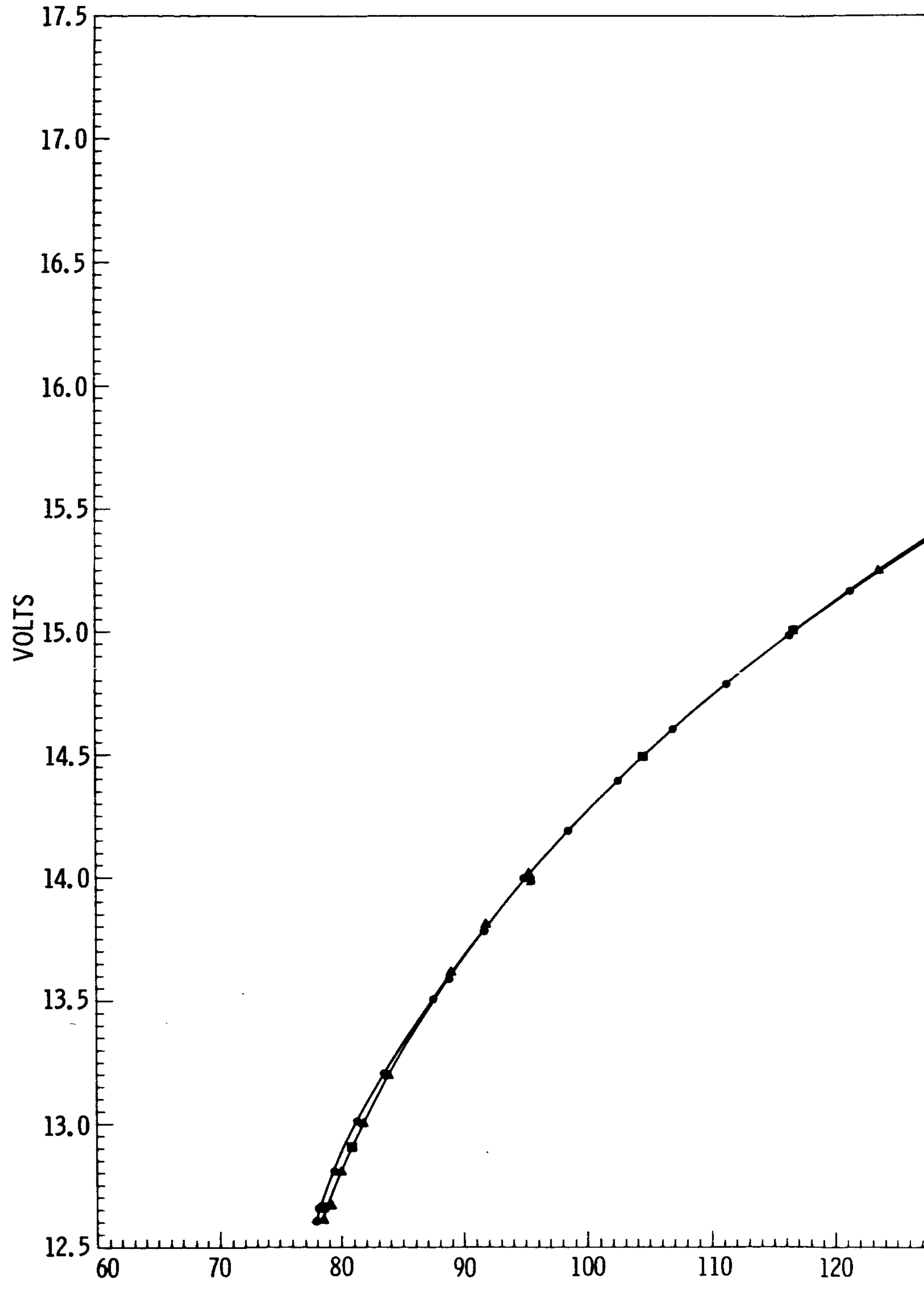
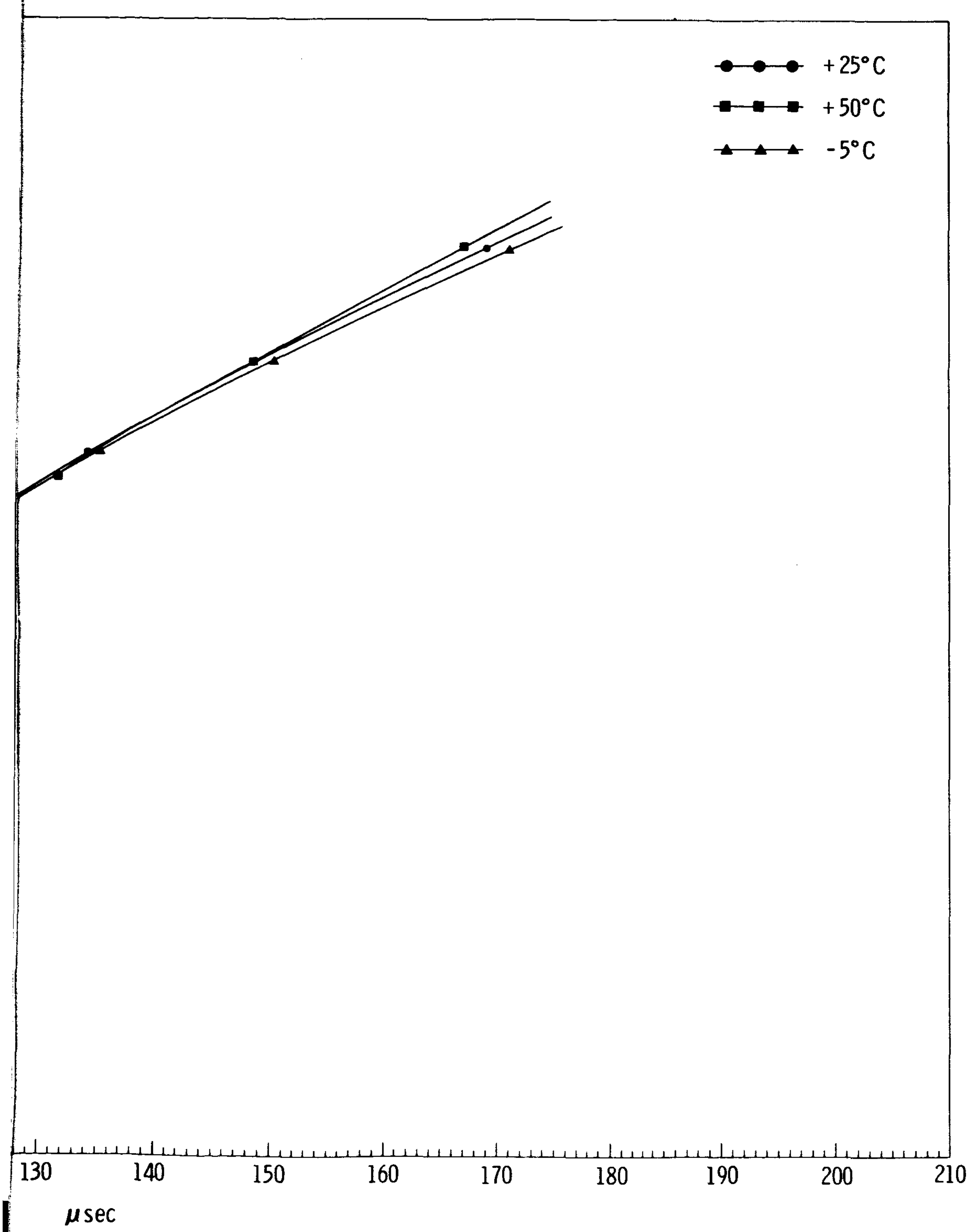


Figure 5-10—PP7 (Unregulated
Microseconds with



Buss Voltage) Telemetry (10-Period Average) in
espect to Temperature and Voltage

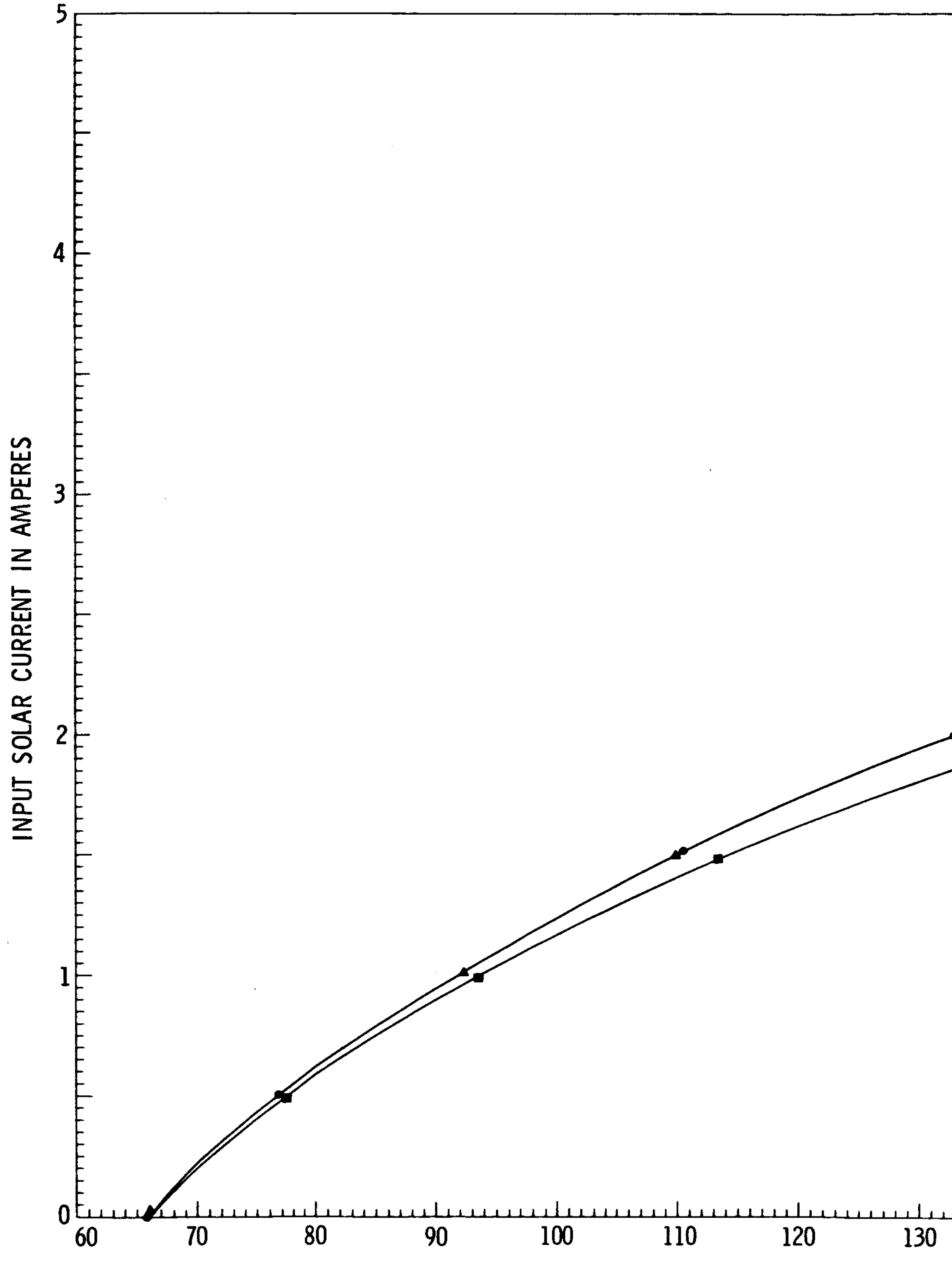
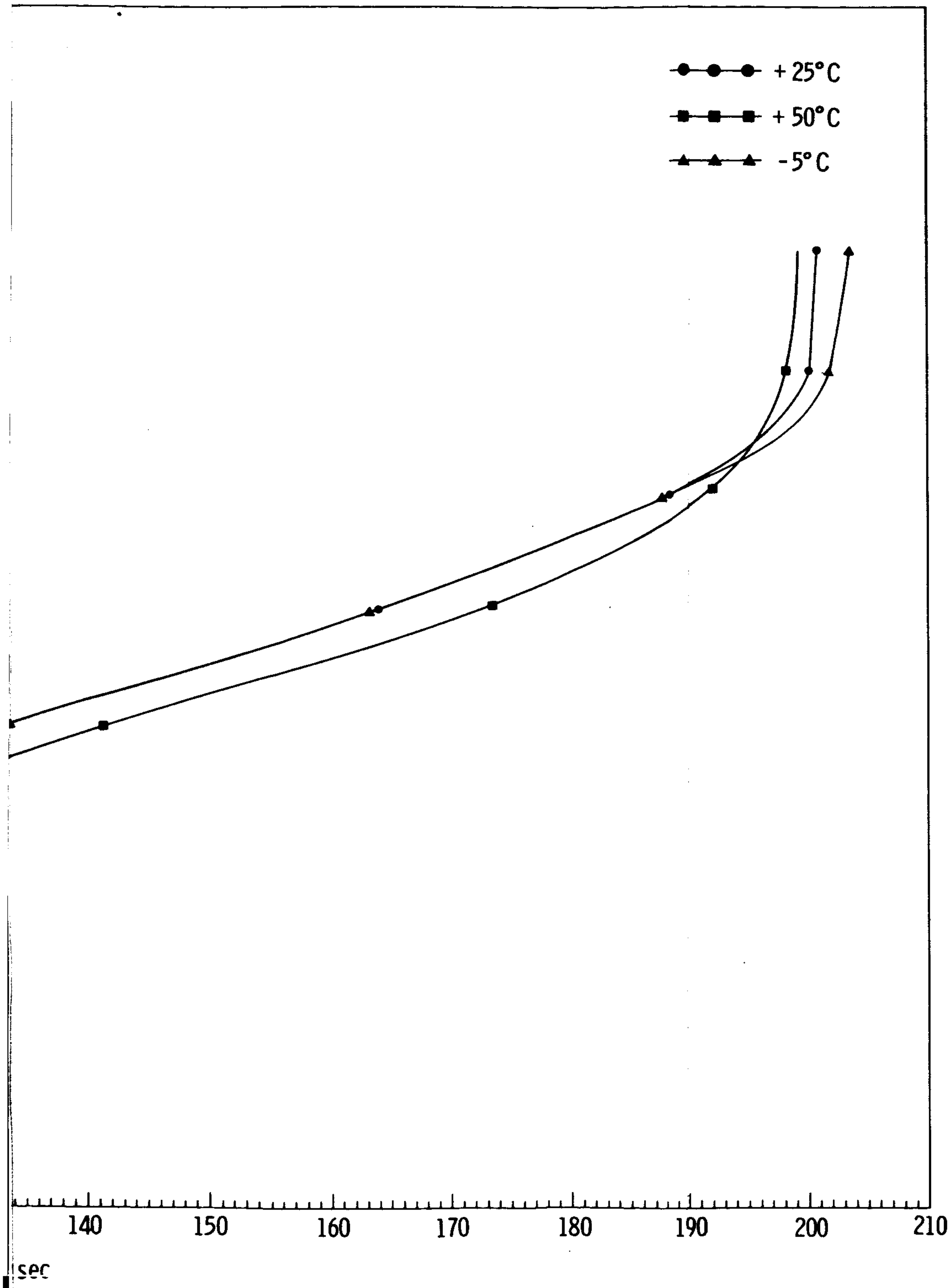


Figure 5-11—PP9 (Solar Current) Teleme
Temper



y (10–Period Average) with Respect to
ture

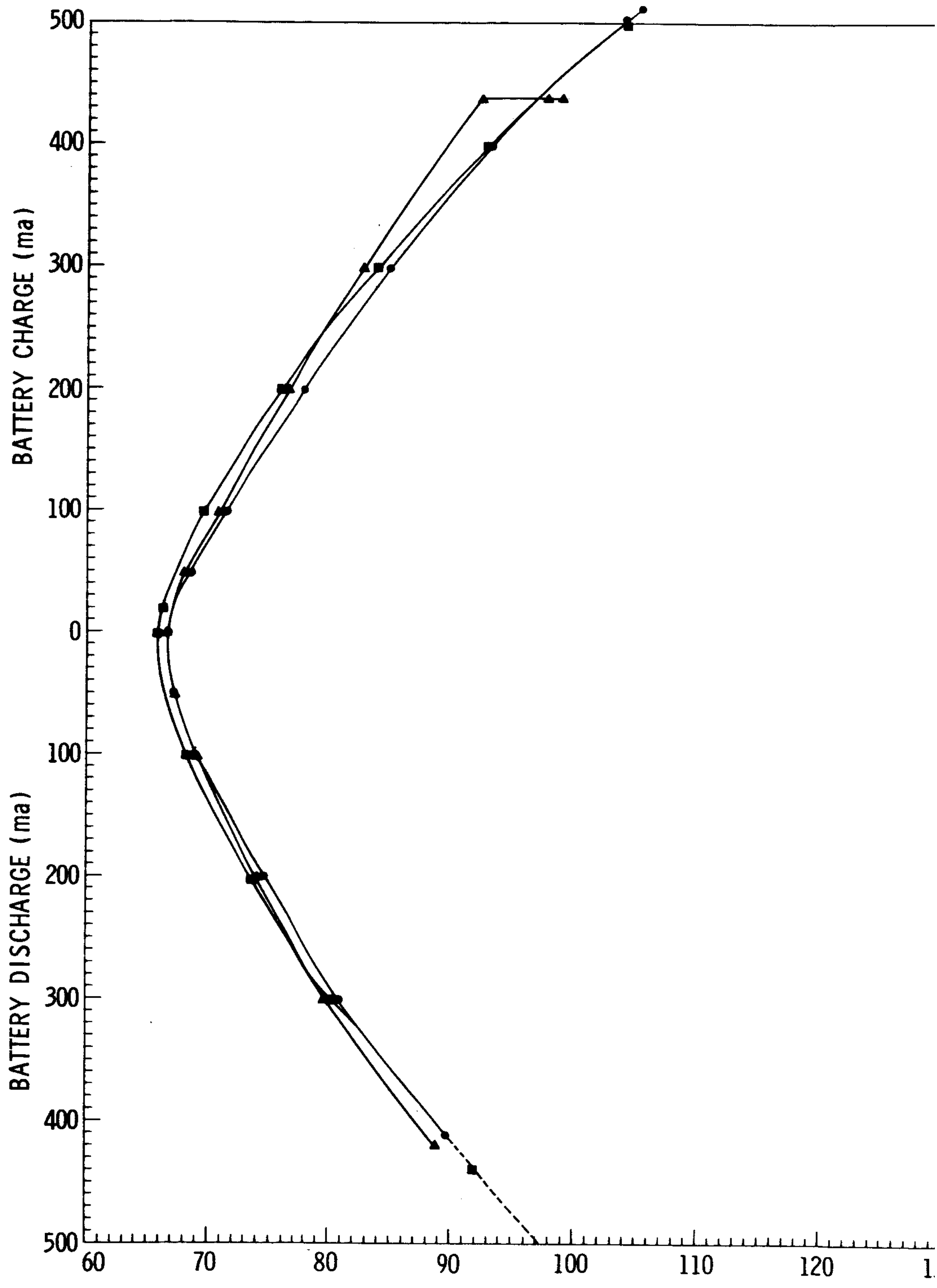
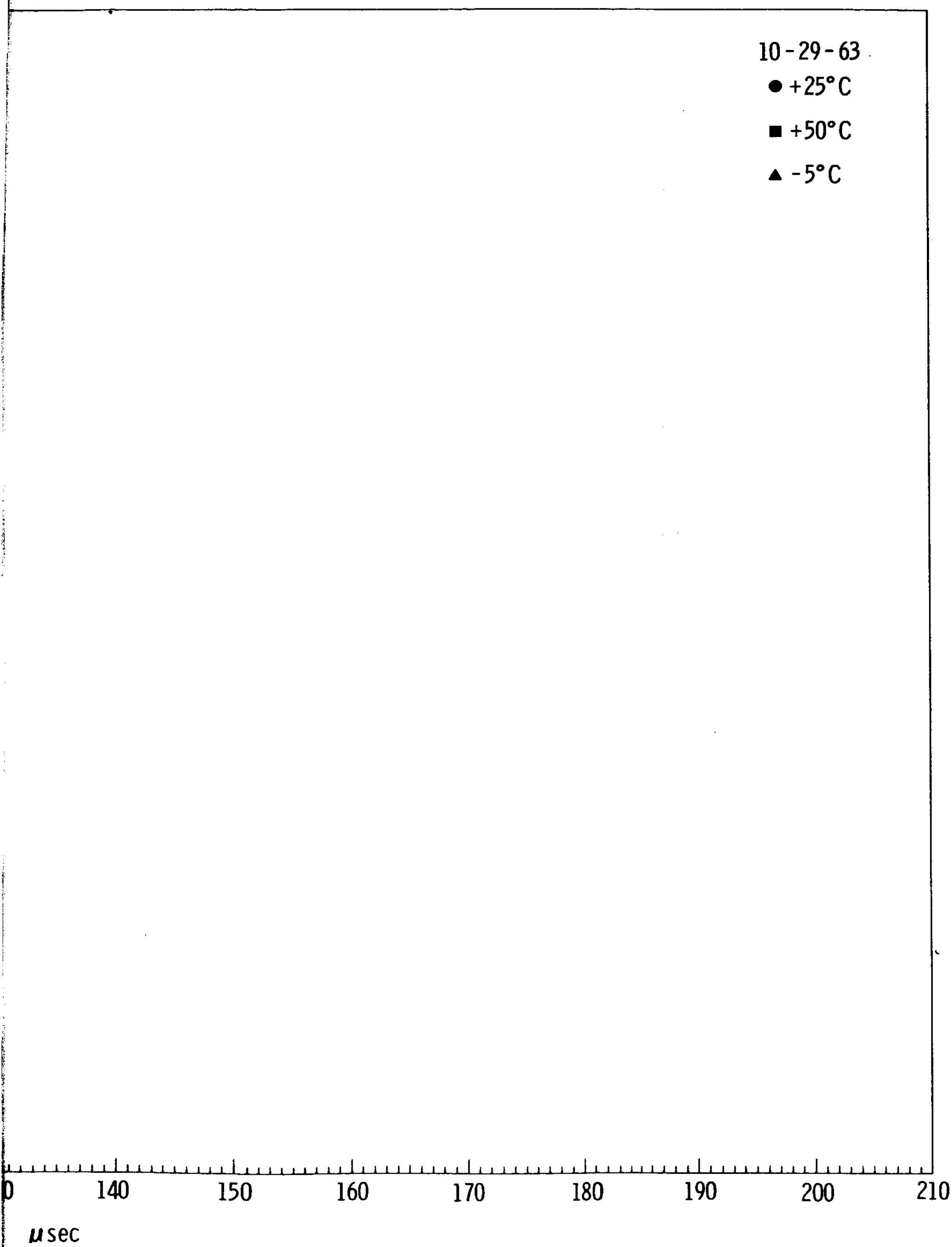


Figure 5-12—PP10 Telemetry (1



)-Period Average) with Respect to Temperature zero solar current, PP10 battery current indicates the spacecraft battery discharge current drain. As solar current is increased to about 420 ma, the spacecraft load is assumed by the solar (charging) current and spacecraft battery discharge current becomes zero. Continued increase in solar current provides for charging the battery (indicated by reversal of PP10) and operation of the spacecraft. The battery charging and protective circuit limits the battery-charging current to about 500 ma. (See Figure 5-12.) The current in excess of that required for battery charging and operating the spacecraft is dissipated (dumped) in resistors. This current is indicated by the performance of PP6. A check of dumping current is readily determined by subtracting spacecraft load current (nominal) and battery-charging current from the indicated solar current. The solar-current sensor continues to indicate the increase in solar current to about 3.5 amperes, at which point the sensor limits and higher solar currents are not detectable.

To provide additional information for use in orbit and test, the following plots were established at an ambient before the thermal-vacuum exposure. A plot of battery overload currents (PP10) to about 150 percent of nominal is shown in Figure 5-13. This curve was accomplished by substituting a resistive load in place of the spacecraft load. In conjunction with the performance of the power parameters PP6, PP7, PP9, and PP10, the voltage drop across the diodes in the battery control and protective circuit was plotted. This plot is shown in Figure 5-14.

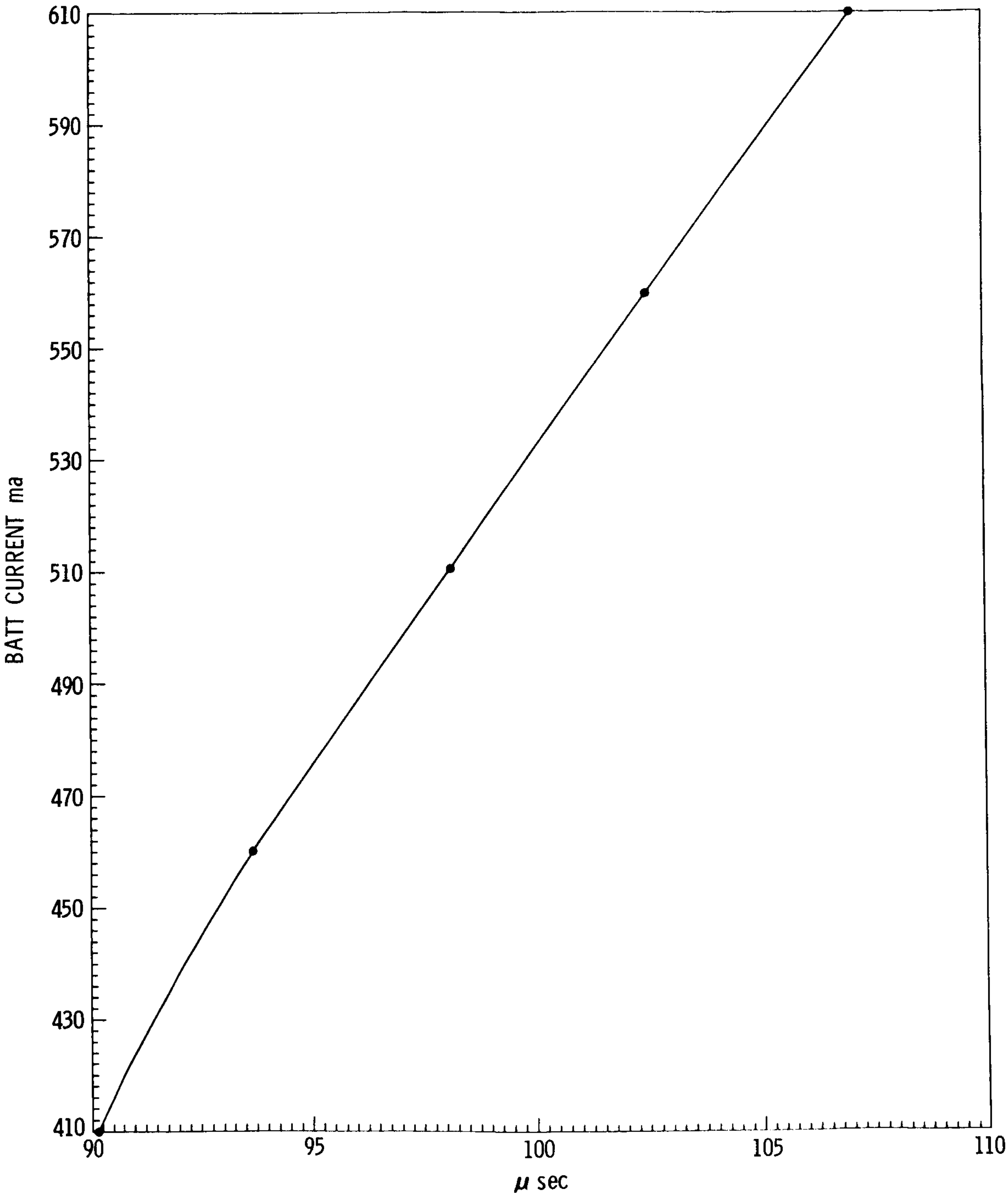


Figure 5-13. PP10 Battery Overload Current

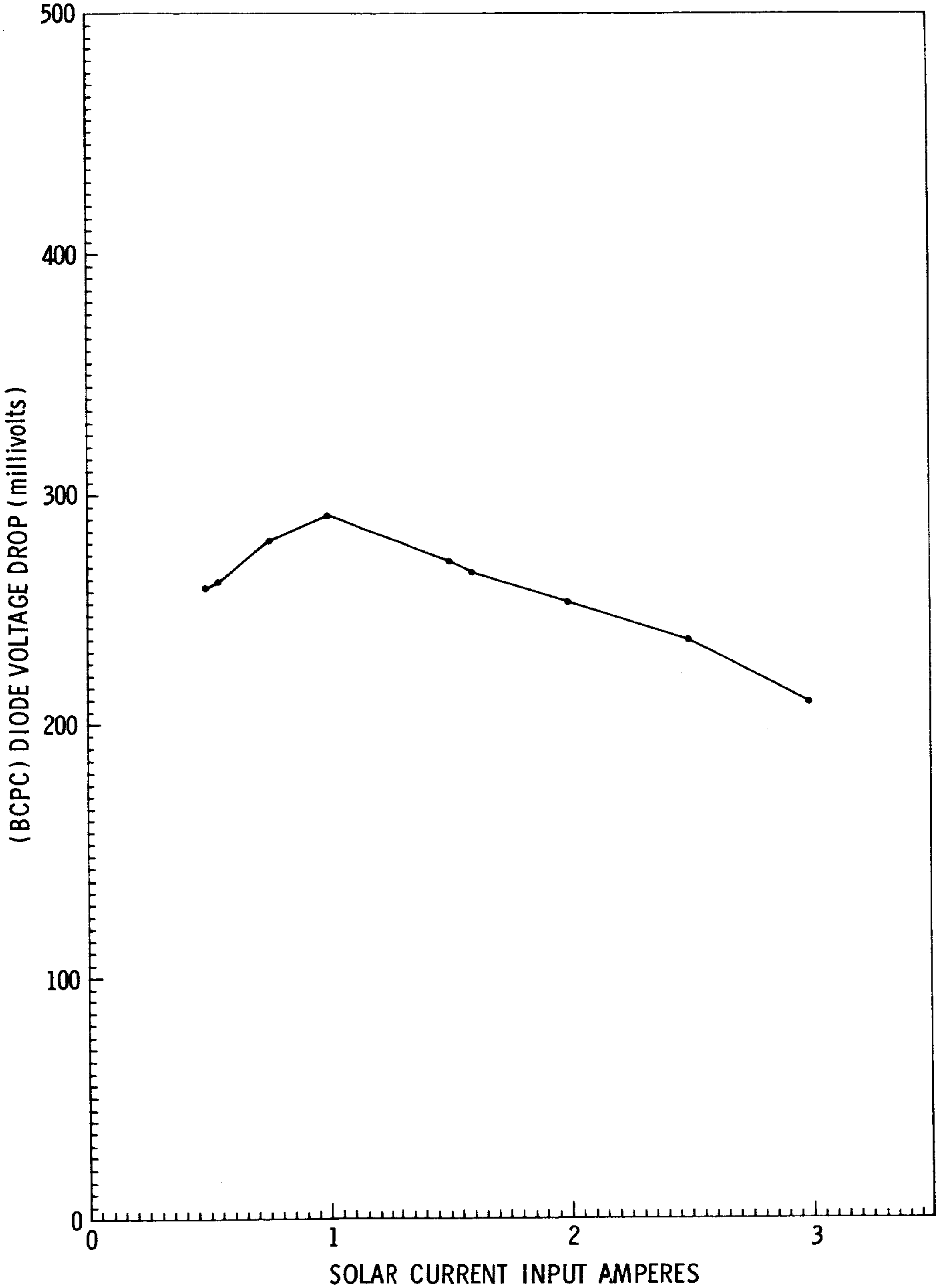


Figure 5-14—Battery Control and Protective Circuit Diode Voltage Drop Versus Solar Current

These performance curves, in conjunction with the temperature calibrations, are invaluable in order to determine the precise performance of the spacecraft in orbit and assist in evaluations during tests.

The remaining performance parameters (PP3, PP4, PP8, and PP15) are covered in their respective experiment sections of this report.

Tables 5-3 through 5-7 show high and low deviations in spacecraft parameter measurements made at each of the three temperature excursions.

- Table 5-3 — Power system measurements
- Tables 5-4 and 5-5 — Programmer system
- Tables 5-6 and 5-7 — Telemetry system

Table 5-7 shows encoder sync and frame identification frequency deviations with respect to exposure. The frequencies are expressed in their reciprocal (the period in μseconds) measured on a 10-period average basis. High and low values are the extremes recorded during the total period at each exposure. The percentage of deviation was determined from the difference of the high and low values divided by the minimum value. Calculations are shown for ambient and for total temperature excursions.

Encoder specifications state:

a. Sync frequency 4.5 kc should be no greater than 4500 $\pm$22 cps at ambient ($\pm$0.48 percent) and 4500 with a total deviation of 45 cps from -10°C to +60°C.

TABLE 5-3

SPACECRAFT PARAMETER DEVIATIONS, POWER SYSTEM
Dates: August 22 to September 5, 1963

Spacecraft: S-52 Flight 1		Exposure: Thermal-Vacuum (8X8)	
Power System			
Parameter	-5° C	Temperature +25° C	+50° C
+ Regulator			
+ 12 v	11.8 → 11.9	11.9	11.9
+ 7.5v	7.48 → 7.52	7.49 → 7.50	7.50 → 7.51
+ 6.5 v	6.43 → 6.45	6.46 → 6.49	6.53 → 6.54
+ 6.0 v	5.99 → 6.00	6.00	6.00 → 6.01
+ 3.0 v	3.11 → 3.12	2.99 → 3.09	3.05 → 3.06
- Regulator			
- 18.0 v	-18.0 → -18.1	-17.7 → -18.0	-18.0
- 6.0 v	- 5.98 → - 5.99	- 5.98 → - 6.00	- 5.98 → - 5.99
- 4.0 v	- 3.92 → - 3.94	- 3.95 → - 4.00	- 4.03 → - 4.04
- 3.0 v	- 2.98 → - 2.99	- 2.95 → - 3.00	-2.99
Inverter			
15 v ac	15	14.8 → 15.0	15.0 → 15.5
Frequency cps	1654 cps → 1713 cps	1661 cps → 1689 cps	1651 cps → 1668 cps
+15 v dc	15.00	14.9 → 15.0	14.9 → 14.95
System current (HS) ma	405 → 425	425	415 → 440
System current (playback) ma	540 → 560	575	590 → 605
System current (undervoltage) ma	67 → 72	82*	95 → 107**
Charging system @ 1 ampere			
Solar paddle volts	15.35 → 16.7	15.1 → 16.0	14.7 → 15.7
Battery charge current ma	202 → 430	500 → 510	485 → 510
Battery trickle charge ma	2.0 → 30	9.0 → 24.5	6.2 → 24.8
Charging System @ 2 amperes			
Battery charge current ma	202 → 430	500 → 512	490 → 515
Battery trickle charge ma	2.0 → 30.0	13.0 → 24.8	8.6 → 25.3

Note: * Post TV
** Measured prior to undervoltage level change

b. Frame identification frequency deviations should be no greater than +1 percent at ambient and a total deviation no greater than 1.5 percent from -10°C to +60°C.

TABLE 5-4

SPACECRAFT PARAMETER DEVIATIONS, PROGRAMMER SYSTEM
August 22, to September 5, 1963

Spacecraft: S-52 Prototype			Exposure: Thermal-Vacuum (8X8)
Programmer System			
	Temperature		
Parameter	-5° C	+25° C	+50° C
Programmer #1			
HS transmitter modulation vp-to-p			
Sync amplitude	9.0	11.5	10.0
Tape recorder input			
Sync amplitude vp-to-p	1.2 → 1.3	1.2 → 1.6	1.2 → 1.4
Tape recorder playback			
Sync amplitude vp-to-p	.95 → 1.0	1.0 → 1.1	.95 → 1.0
LS transmitter modulation			
Sync amplitude vp-to-p	9.0 → 10.0	9.0 → 10.0	9.0 → 10.0
Data storage card and tape recorder			
Number of playbacks	28	6	25
Total playback time (min)	72.33	14.55	59.79
Playback osc rate (sec)	1.461 → 1.521	1.40 → 1.44	1.366 → 1.411
Playback time (sec)	149 → 161	143 → 148	142 → 145
Ø 1 amplitude volts	1.2 → 1.4	1.3 → 1.4	1.15 → 1.25
Ø 2 amplitude volts	1.2 → 1.4	1.25 → 1.4	1.15 → 1.25
Log Ø 2 - Ø 1 amplitude degrees	2.9 → 5.0	5.0	1.5 → 4.6
Programmer #2			
Sunrise level volts	Min - Sec	Min - Sec	Min - Sec
T_o + 6 min	6 0	6 0	6 15
T_o + 60 min	61 43	60 0	59 50
T_o + 78 min	78 32	76 30	77 45
T_o + 110 min	110 28	10 30	111 30
Timers, 1-Year			
Timer A current μa	30.0 → 31.5	30.0 → 31.5	26.5 → 32.0
Timer B current μa	30.0 → 31.5	30.0 → 31.5	26.5 → 32.0
Undervoltage Detector			
Undervoltage level volts	12.2 → 12.9	12.3 → 13.05	12.6 → 13.05
Osc #1 period (sec)	57.985 → 63.804	59.454 → 65.098	61.067 → 67.567
Osc #2 period (sec)	51.795 → 64.788	54.153 → 65.529	58.209 → 67.032

TABLE 5-5

UNDERVOLTAGE

Duration of under-voltage	J4 Dump Volts	J6 Dump Volts	Batt A Volts	Batt B Volts	Batt B DISC. I ma	Osc Rate #1 Count	Osc Rate #2 Count	AC Volts (p to p)	AC Freq (cps)	Pin 45 Volts	E Chrg	I Chrg	Osc #1 period seconds	Osc #2 period seconds	Trickle Chrg ma	Chrg Duration	Temp C°
17 hr 54 min 0 sec	–	–	15.0 BEGIN 14.8 END	14.9 BEGIN 14.1 END	72.0 67.0	994	1028	15	1596 MIN. MAX. 1607	15.0	–	–	63.755 MAX. MIN. 63.349	64.751 MAX. MIN. 64.545	–	NONE	-5
17 hr 49 min 57 sec	–	–	14.2 BEGIN END 14.0	14.05 BEGIN END 13.5	107.0 97.0	1005	N.A. MECH COUN-TER NO GOOD	15.0 15.3	1620 MAX. MIN. 1609	14.9	–	–	65.356 MAX. MIN. 63.970	65.300 MAX. MIN. 63.315	–	NONE	50

TABLE 5-6

SPACECRAFT PARAMETER DEVIATIONS, TELEMETRY SYSTEM

August 22 to September 25, 1963

Spacecraft: S-52 Flight 1 — Exposure: Thermal Vacuum (8X8)

Telemetry System

Parameter	Temperature -5° C	+25° C	+50° C
Transmitter			
* Power mw	170 → 190	163 → 180	132 → 175
Frequency 136. Mc	558165 → 558479	558807 → 559201	558931 → 559182
Command receiver			
* Sensitivity db	91 → 97	100 → 104	102 → 108
Encoder			
Sync Msec	0 → 4.62	4.5 → 4.65	4.5 → 4.62
A Amplitude v p-to-p	-1.8 → -0.4	-3.5	-1.5 → -1.8
period ms	13.962	13.9609	13.9606 → 13.9610
L amplitude	0 to -4.0	0 to -4.0	(0 to -3.8)→(0 to -4.0)
period sec	4.6 → 4.654	4.654	4.6517 → 4.6536
T amplitude volts	0 to -4	0 to -4	(0 to -3.8)→(0 to -4.0)
period ms	18.1797	18.179	18.177 → 18.181
HS video amplitude v p-to-p			
Sync	1.5 → 1.6	1.7 → 2.0	1.5 → 1.6
LS gate B volts	-5.9 → -5.98	-5.90 → -6.0	-5.93 → -5.98
LS envelope volts	(-2.5 to +5.0)→(-3.0 to +5.0)	(-2.5 to +5.0) (-3.0 to +5.0)	(-2.5 to +5.5) (-3.0 to +5.0)
period msec	872.6 → 872.91	872.6	870.6 → 872.6
LS Video	(0 to -3.9)→(0 to -4.0)	(0 to -3.8)→(0 to -4.0)	(0 to -3.8)→(0 to -4.0)
LS before 48 volts	(0.5 to -6.0)→(1.0 to 6.5)	0 to 6.0	(0 to 6.0) → (0 to 6.5)
Sync v p-to-p	3.5 → 4.0	4.0	4 → 4.5
LS sync μsec	222.6 → 223.1	221.4 → 222.3	221.9 → 223.0

*The same cable lengths and attenuation were used for these measurements throughout these tests

TABLE 5-7

IDENTIFICATION FREQUENCY DEVIATIONS

$$\left(\%\Delta = \frac{H-L}{L} \times 100\%\right)$$

Frame	-5° C		+25° C		+25° C %Δ	+50° C		Total Deviation -5° C to +50° C Δ%
	Lo μ sec	Hi μ sec	Lo μ sec	Hi μ sec		Lo μ sec	Hi μ sec	
0	197.4	197.7	195.9	196.3	0.2	196.0	196.5	1.02
1	221.4	222.0	220.1	222.6	1.13	221.7	222.7	1.22
2	160.0	160.5	158.7	159.0	0.18	158.6	159.1	1.19
3	221.4	222.0	220.1	222.5		221.7	222.6	
4	133.9	134.4	133.0	133.1	0.07	132	133.9	1.03
5	221.4	222.0	220.0	222.6		221.7	222.6	
6	115.8	116.2	115.0	115.1	0.08	114.8	115.1	1.21
7	221.5	221.9	220.0	222.6		221.7	222.6	
8	101.3	101.6	100.6	100.7	0.09	100.5	100.9	1.09
9	221.4	222.0	220.0	222.6		221.7	222.7	
10	90.4	90.9	90.1	90.2	0.11	90.1	90.3	0.88
11	221.4	221.9	220.0	222.6		221.7	222.7	
12	82.0	82.1	81.4	81.5	0.12	81.3	81.6	0.98
13	221.4	221.9	220.0	222.6		221.7	222.6	
14	75.0	75.7	74.6	74.7	0.13	74.6	74.7	1.48
15	221.4	222.0	220.0	222.5		221.7	222.7	

NOTE: Two important factors must be considered in analyzing this data:

1. The test-stand ground station has an accuracy in the order of 1 percent.

2. The encoder cards experienced a temperature excursion from -14.5 to +61.5°C (reference T&E Memorandum Report #632-13 dated January 22, 1964, "Results of the Thermal-Vacuum Flight Acceptance Test of the UK-2/S-52 International Ionosphere Satellite," by K. Rosette)

In addition, on July 22, 1963, the Data Instrumentation Development Branch at GSFC provided data reduction of a 45-minute spacecraft transmission to Litton (spacecraft ambient conditions). This reduction provided a resolution of 50 cps. All frequencies fell within their assignments.

The encoder is considered to have performed as intended.

Typical examples of the discriminator strip charts are shown of the encoder frequencies present on telemetry channel 0 for each stabilized temperature exposure, Figure 5-15.

These real-time plots were obtained from the decommutator and discriminator designed and fabricated by the Data Instrumentation Development Branch, Data Systems Division, GSFC. These real time display greatly facilitated correlation of telemetry, stimulus, and hardline data. The discriminator strip charts permitted relative comparisons of the excited experiments at the different temperature levels.

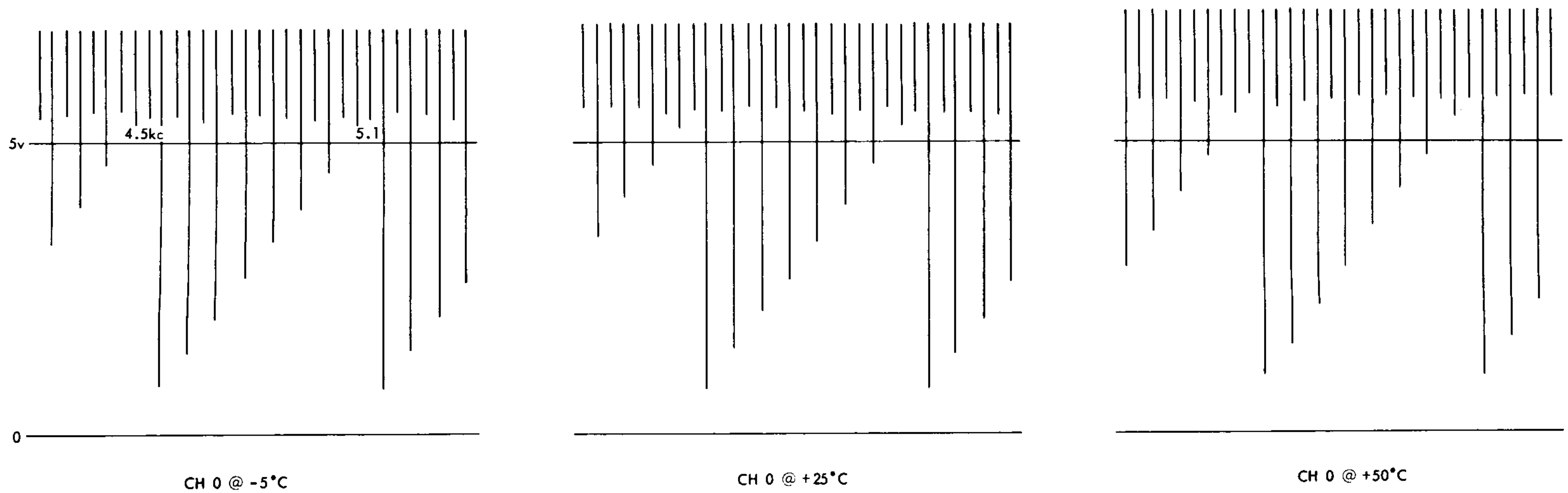


Figure 5-15—Discriminator Strip Charts of Channel 0 at -5°C, +25° C, and +50° C

6. MICROMETEORITE EXPERIMENT TEST RESULTS

The micrometeorite experimenter has made design changes based on the wide variations in amplifier gain shown by the excursions in Table 6-1. The change in gains recorded was derived from the fixed-input-generator measurements.

Typical examples of strip-chart plots of micrometeorite experiment telemetry outputs are shown in Figures 6-1 through 6-9.

TABLE 6-1

MICROMETEORITE EXPERIMENTS, BRUSH RECORDER CALIBRATIONS

	-5° C	25° C	+50° C	Total Excursion
IROD A	48.4 → 60	52 → 54	51 → 60	48.4 → 60
IROD B	52.7 → 66.7	52.7 → 56	48 → 62.5	48 → 66.7
DROD A				
PRE	46.2 → 56	36.3 → 41	9.4 → 16.2	9.4 → 56
POST	46.1 → 64	39.5 → 51	4.06 → 8.33	4.06 → 64
DROD B				
PRE	52.3 → 68	42 → 47.5	12.5 → 25	12.5 → 68
POST	46.6 → 63.6	41.9 → 57	4.7 → 18	4.7 → 63.6

Recorded values are voltage gains determined from available hardline voltage outputs of micrometeorite experiment amplifiers excited by fixed-amplitude independent pulse generators.

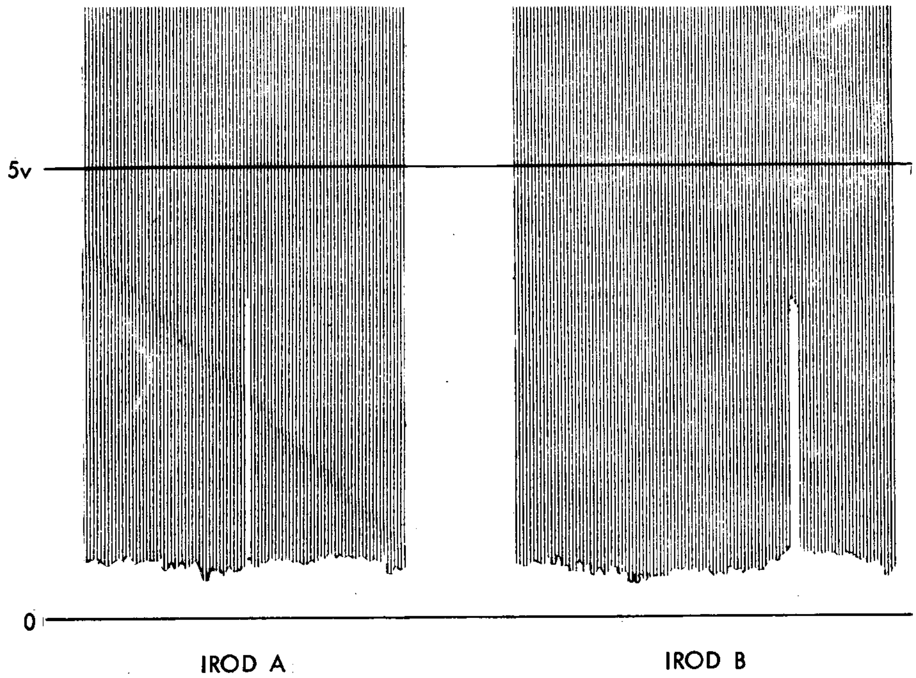


Figure 6-1—Discriminator Strip Chart of Excited Micrometeorite IROD From Pulse Generator at -5°C

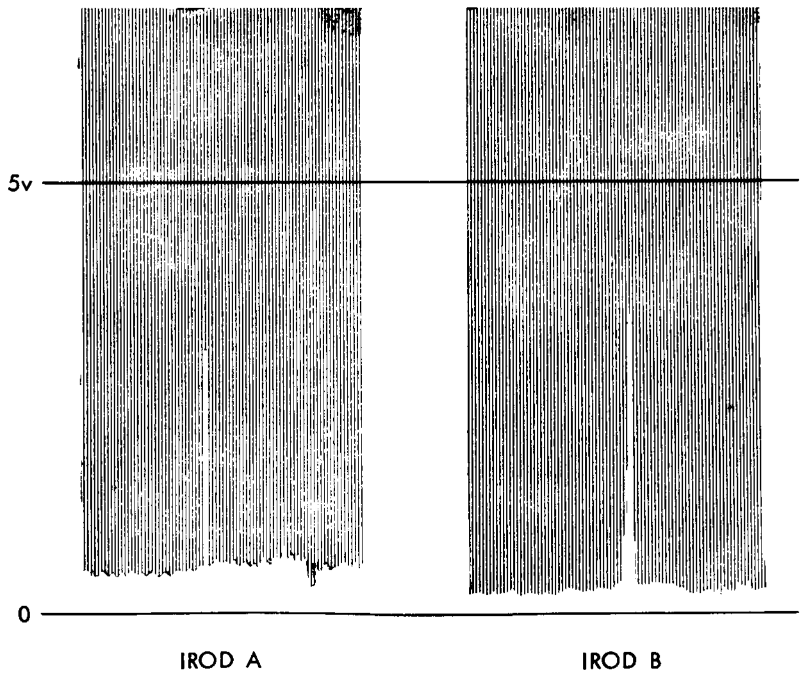


Figure 6-2—Discriminator Strip Chart of Excited Micrometeorite IROD From Pulse Generator at Ambient

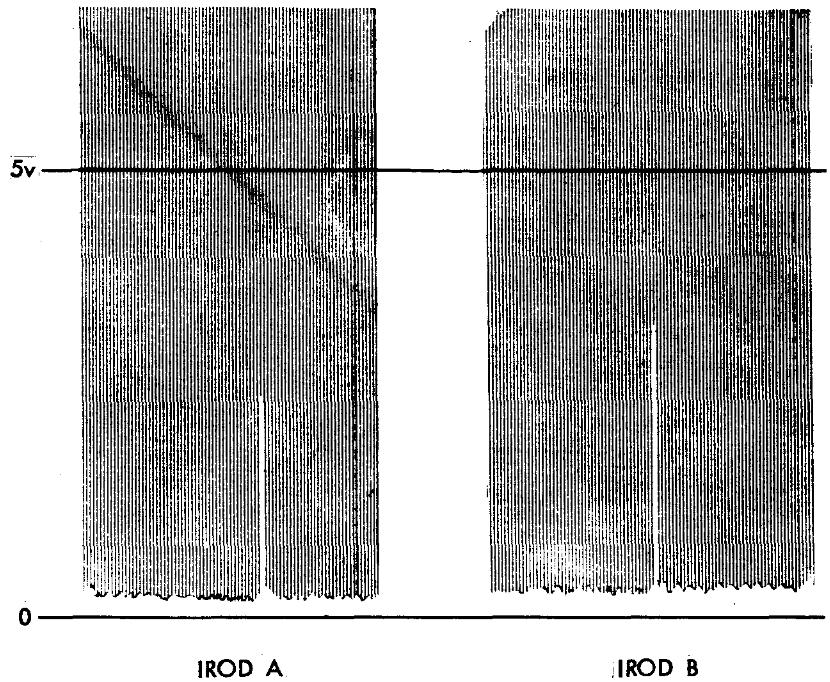


Figure 6-3—Discriminator Strip Chart of Excited Micrometeorite IROD From Pulse Generator at +50°C

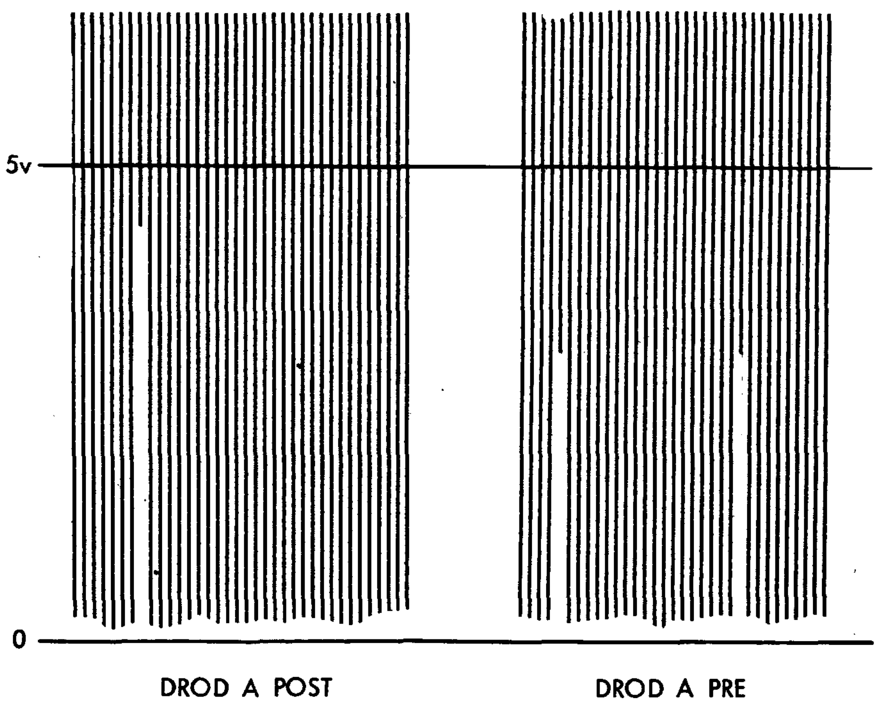


Figure 6-4—Discriminator Strip Chart of Excited Micrometeorite DROD A From Pulse Generator at -5°C

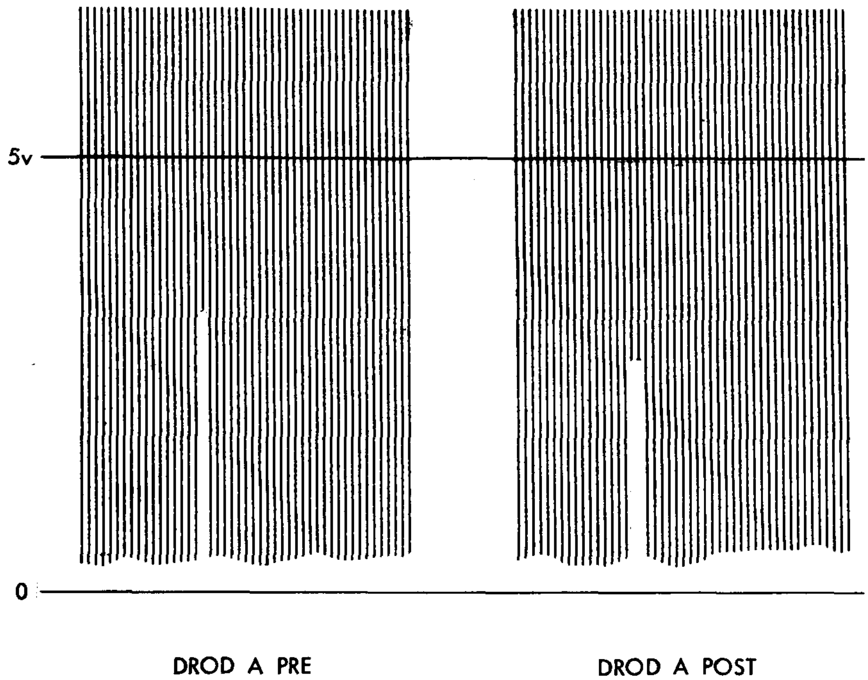


Figure 6-5—Discriminator Strip Chart of Excited Micrometeorite DROD A From Pulse Generator at Ambient

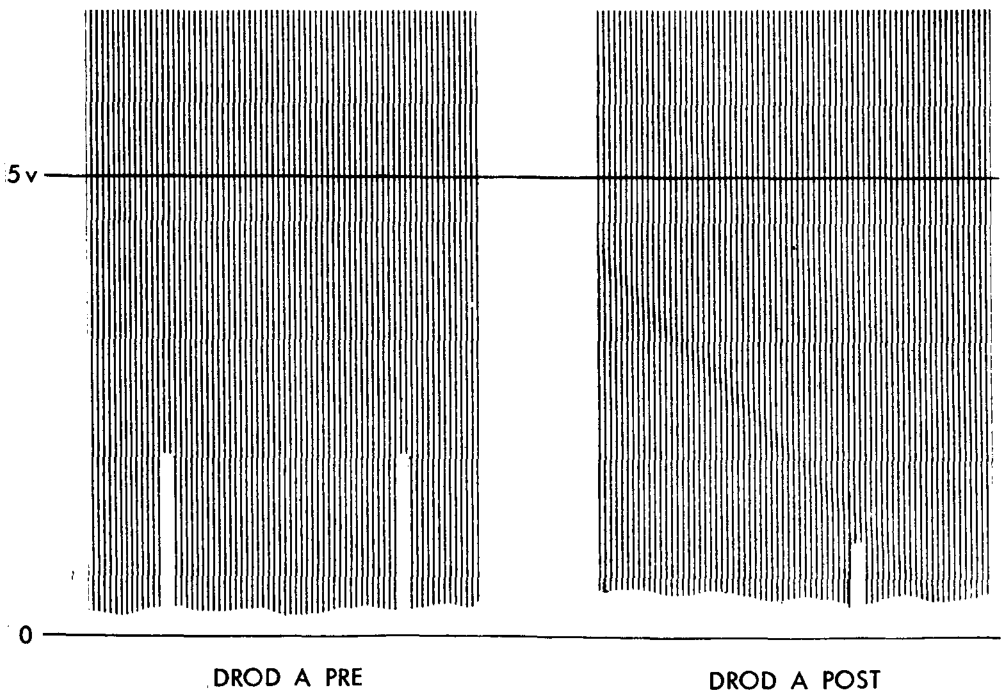


Figure 6-6—Discriminator Strip Chart of Excited Micrometeorite DROD A From Pulse Generator at +50°C

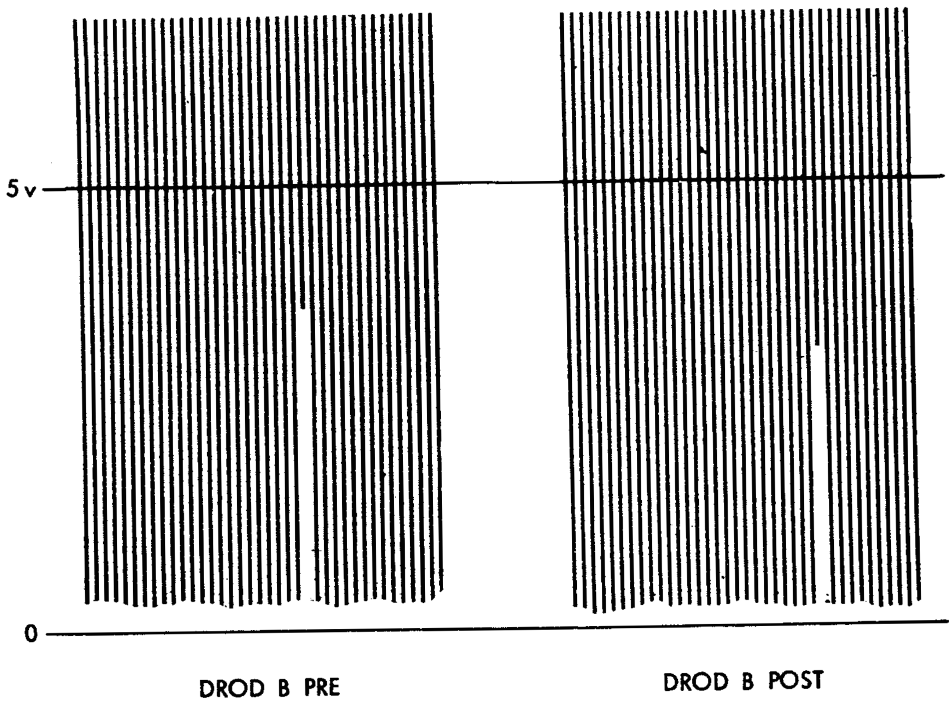


Figure 6-7—Discriminator Strip Chart of Excited Micrometeorite DROD B From Pulse Generator at -5°C

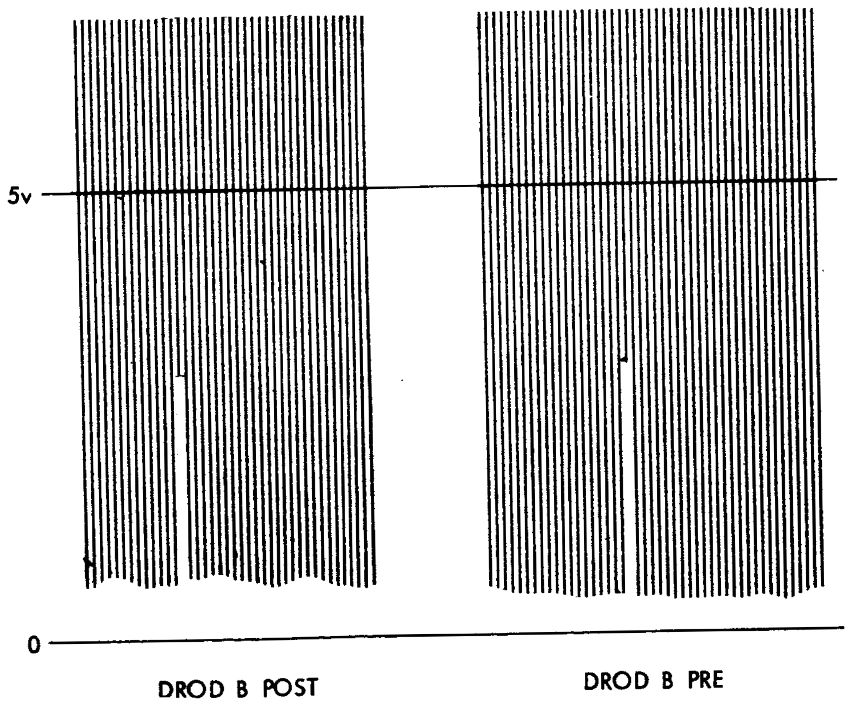


Figure 6-8—Discriminator Strip Chart of Excited Micrometeorite DROD B From Pulse Generator at Ambient

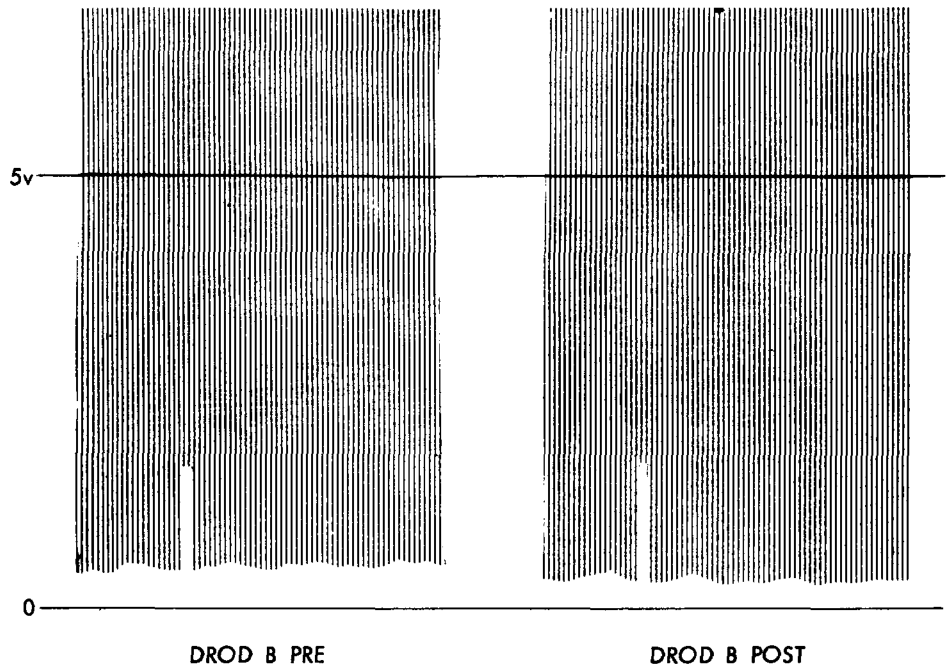


Figure 6-9—Discriminator Strip Chart of Excited Micrometeorite DROD B From Pulse Generator at +50° C

As described in the test procedures, the galactic-noise experiment was self-excited although periodic checks were made with the test oscillator. Figures 6-10 through 6-12 show the discriminator strip charts from the recovered spacecraft telemetry. The lower trace is a plot of all words available on the galactic-noise experiment sampling channels, 2, 6, 10, and 14, on the high-speed telemetry format. The upper trace is a plot of all the words present on channel 8 in the same sampling period. The galactic-noise experiment sweep appears as word 15 on channel 8, and the sweep is indicated by the line drawn through these points.

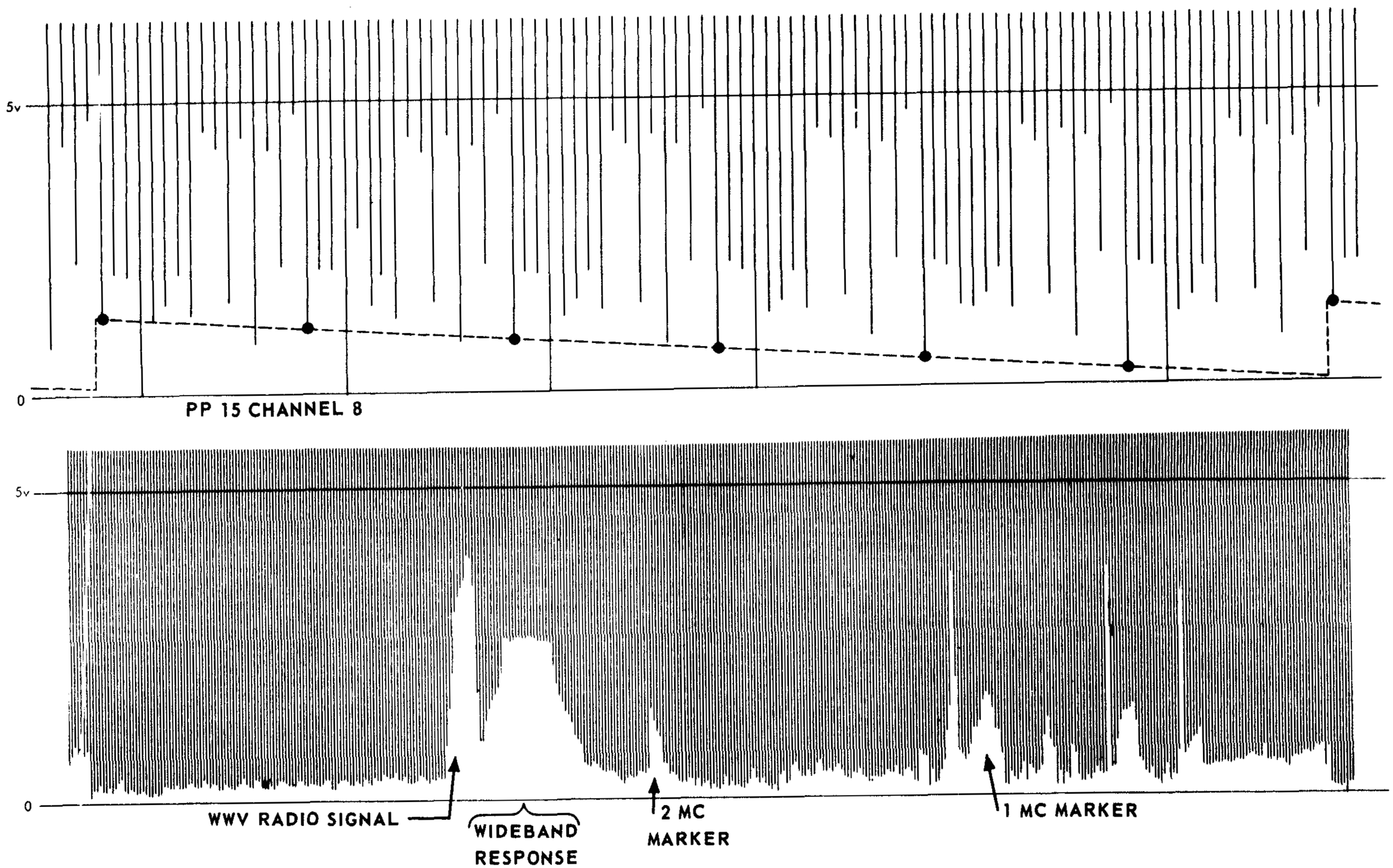


Figure 6-10—Discriminator Strip Chart of Excited Galactic-Noise (High Speed) Experiment at -5°C

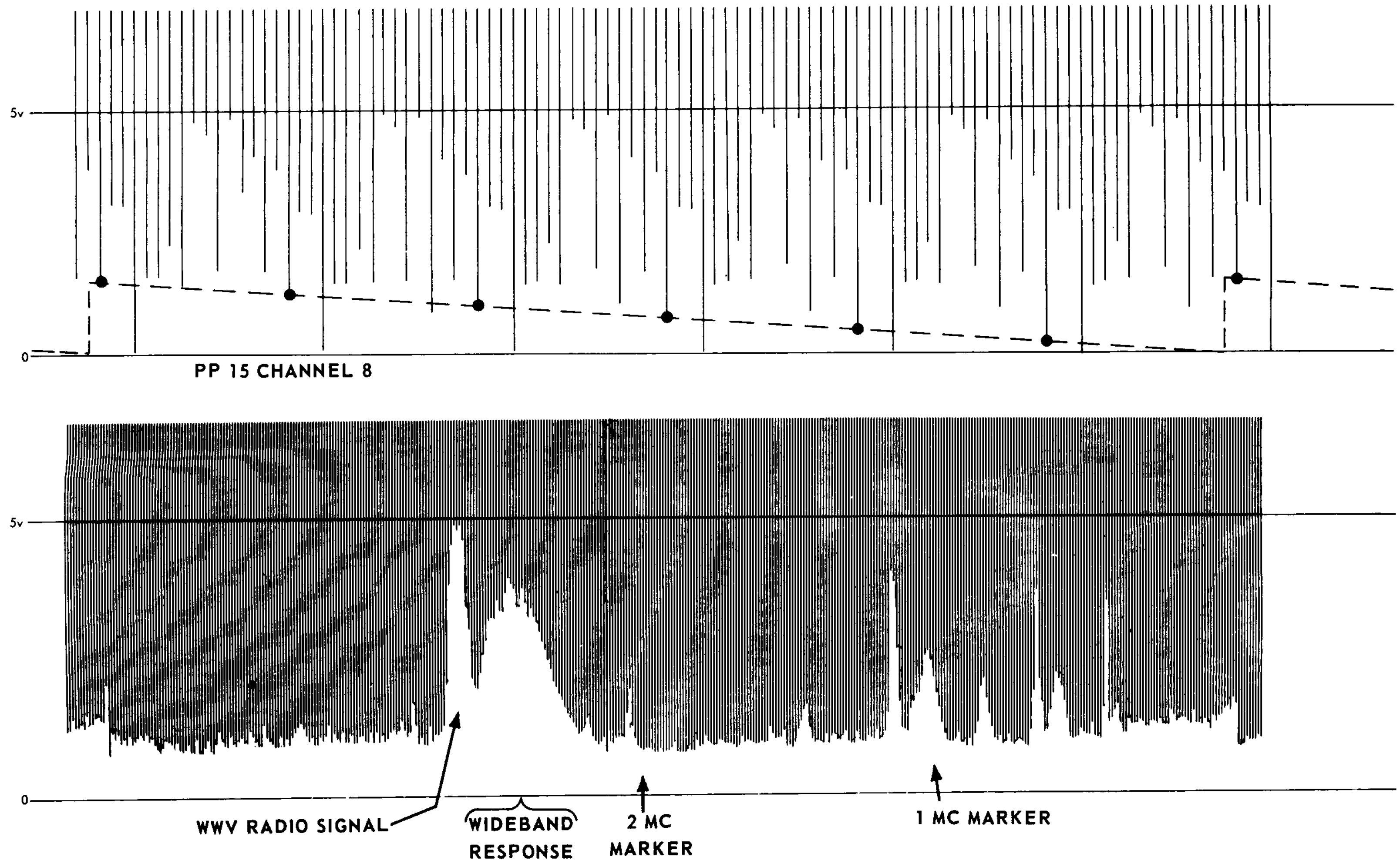


Figure 6-11—Discriminator Strip Chart of Excited Galactic-Noise (High Speed) Experiment at +25° C

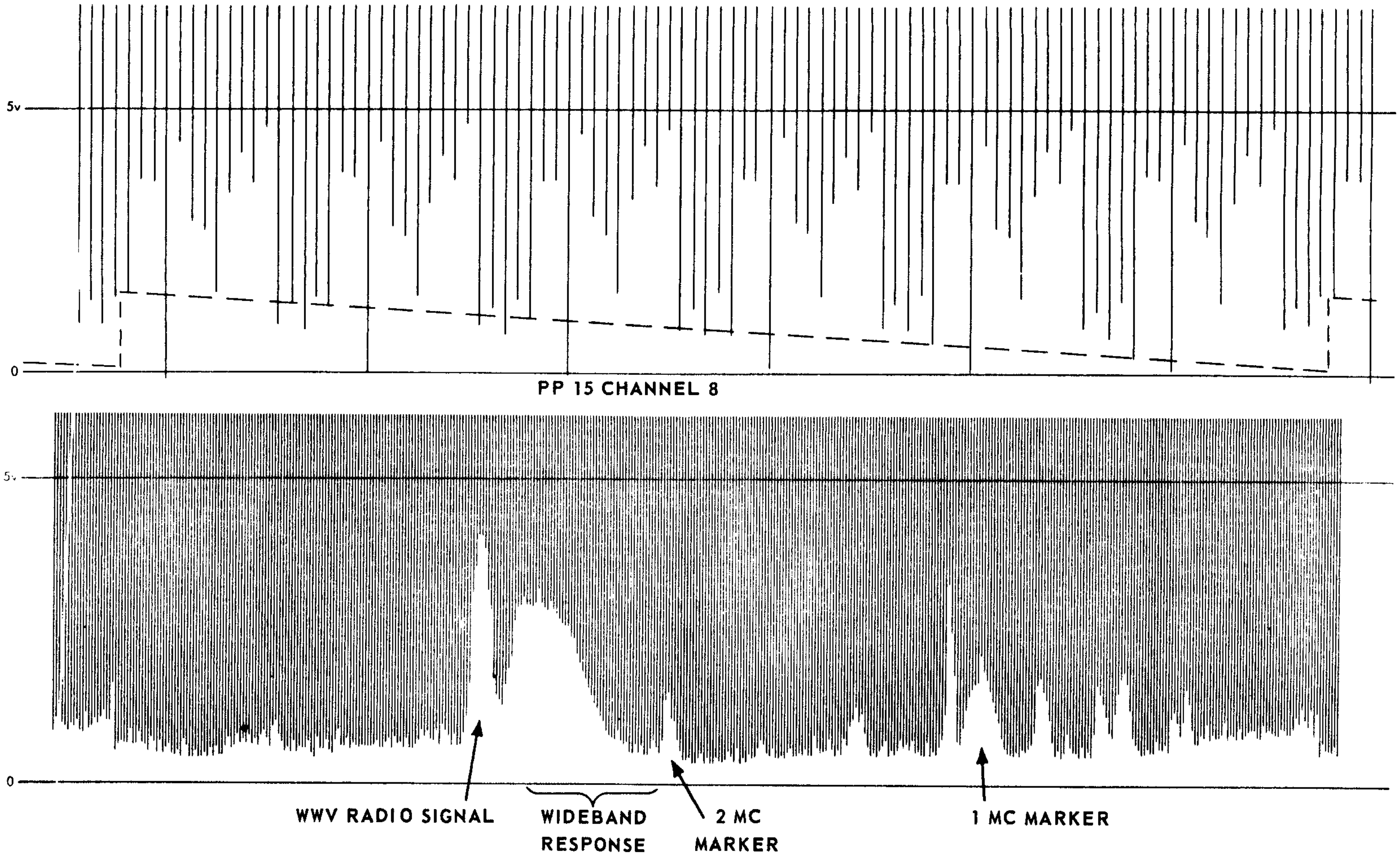


Figure 6-12—Discriminator Strip Chart of Excited Galactic-Noise (High Speed) Experiment at +50° C

Figure 6-13 shows the recovered tape recorder playback of excited galactic-noise experiment.

Table 6-2 shows PP8 and PP15 telemetry in μsec of the galactic-noise reel voltage and sweep, with respect to temperature.

Table 6-3 indicates the status of the galactic-noise batteries throughout the exposures.

TABLE 6-2

PP 8 AND PP 15 TELEMETRY

Description	Temperature		
	-5° C (μsec)	$+25^\circ$ C (μsec)	$+50^\circ$ C (μsec)
PP 8 +12v (Galactic-noise reel)	81.9	81.7	82.0
PP 15 (Galactic-noise receiver sweep)	69.0 71.4 73.9 76.3 79.4 82.3	69.0 71.3 73.9 76.4 79.2 82.2	69.5 71.9 74.4 77.0 79.8 82.8

TABLE 6-3

BATTERY STATUS THROUGHOUT EXPOSURES

	Temperature		
	-5° C (v)	$+25^\circ$ C (v)	$+50^\circ$ C (v)
Galactic-noise battery A	12.5 → 12.6	12.5 → 12.9	12.4 → 12.5
Galactic-noise battery B	12.5 → 12.6	12.4 → 12.9	12.35 → 12.5

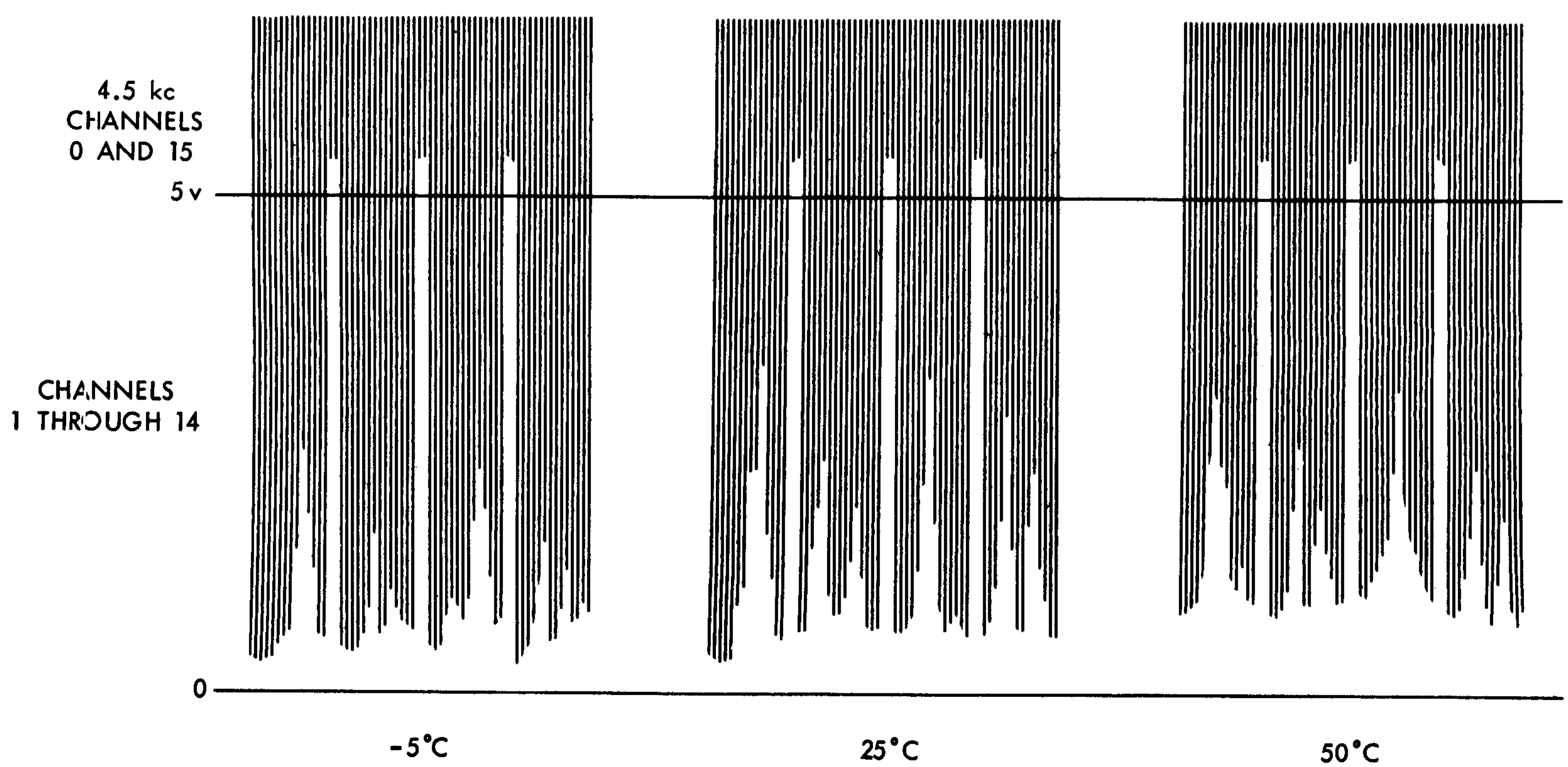


Figure 6-13—Discriminator Strip Chart of Excited Galatic-Noise (Lo-Speed) Experiment at +50°C

7. OZONE EXPERIMENT

The ozone experiment consists of two parts, a pair of photomultiplier spectrometers (PMA and PMB) and a broadband unit containing an ozone cell and a monitor cell. Table 7-1 shows, in μsec, variations with respect to temperature in voltage converted from PP3 telemetry (extra high tension). Table 7-2 provides ozone calibration data and shows the composite high-low values of the hardline output voltages measured at the test stand for each sensor in the exciter light OFF (quiescent) condition and with the exciter lamp ON are given for each temperature exposure. Included are currents from monitor test solar cells, located in front of the exciter lamps, which indicate the relative intensities of the ultraviolet exciter lamps. Using the ozone calibration box with four fixed input currents, Table 7-2 shows the high-low deviations (in volts) in the sensor hardline output voltages and corresponding changes (in μsec) in the recovered telemetry data. The values are shown for ambient and for each of the exposed temperature extremities.

TABLE 7-1

PP 3 TELEMETRY

Description	-5° C (v)		+25° C (v)		+50° C (v)	
PP 3 (EHT)	1.25	1.47	1.26	1.81	0.915	1.055

TABLE 7-2

OZONE CALIBRATION

Cal. Box Pos.	PMA @ +25° C					-5° C					+50° C				
	HL (13)			TM		HL (13)			TM		HL (13)			TM	
	Input	Lo	Hi	Lo	Hi	Input	Lo	Hi	Lo	Hi	Input	Lo	Hi	Lo	Hi
4	-33.0	4.55	4.57	167.3	170.5	- 33.0	4.37	4.41	160.9	162.7	- 33.0	4.71	4.76	178.3	182.4
3	-22.0	3.08	3.14	111.5	114.1	- 22.0	2.88	2.91	107.0	108.8	- 22.0	3.34	3.40	118.0	120.0
2	-11.0	1.59	1.68	83.7	85.2	- 11.0	1.36	1.40	80.5	81.8	- 11.1	1.93	1.99	88.1	90.0
1	-1.82	.412	.530	70.1	71.0	- 1.81	.171	.215	68.0	68.5	- 1.81	.817	.877	74.0	75.0
OFF	-.197	.269	.389	68.6	70.0	-.242 to -.248	.040	.089	66.8	67.6	-.153 to -.158	.664	.722	72.8	73.3
	PMB @ +25° C					-5° C					+50° C				
4	-33.0	4.35	4.41	156.8	160.1	- 33.0	4.19	4.23	150.0	152.1	- 33.0	4.55	4.60	167.2	169.0
3	-22.0	2.95	3.03	108.2	110.2	- 22.0	2.77	2.80	104.7	105.2	- 22.0	3.22	3.27	114.9	115.8
2	-11.0	1.54	1.65	82.7	84.6	- 11.0	1.33	1.37	80.6	80.9	- 11.1	1.87	1.94	87.9	88.2
1	-1.82	.416	.540	70.1	71.3	- 1.81	.186	.229	68.1	68.4	- 1.81	.801	.870	74.1	74.5
OFF	-.197	.267	.389	68.6	70.0	-.242 to -.248	.038	.084	66.9	67.2	-.153 to -.158	.651	.724	72.6	73.2
	MON @ +25° C					-5° C					+50° C				
4	-33.0	4.62	4.64	171.1	171.3	- 33.0	4.52	4.56	166.3	167.3	- 33.0	4.70	4.77	175.6	177.8
3	-22.0	3.18	3.21	113.2	114.1	- 22.0	3.07	3.11	111.3	112.3	- 22.0	3.31	3.36	116.9	118.0
2	-11.0	1.71	1.76	85.0	85.5	- 11.0	1.60	1.63	83.6	84.3	- 11.1	1.88	1.95	87.6	88.4
1	-1.82	.540	.596	71.0	71.6	- 1.81	.404	.442	68.9	70.5	- 1.81	.751	.807	73.4	74.0
OFF	-.197	.370	.425	69.6	69.9	-.242 to .248	.237	.290	68.2	68.5	-.153 to -.158	.518	.631	71.6	72.2
	OZ @ +25° C					-5° C					+50° C				
4	-33.0	1.76	1.79	85.6	86.2	- 33.0	1.66	1.69	84.3	85.7	- 33.0	1.90	1.95	87.0	88.2
3	-22.0	1.29	1.32	79.2	79.7	- 22.0	1.19	1.22	78.0	78.8	- 22.0	1.42	1.48	81.3	82.0
2	-11.0	.814	.854	73.8	74.3	- 11.0	.718	.747	73.1	73.7	- 11.1	.959	1.02	75.7	76.4
1	-1.82	.434	.477	70.0	70.5	- 1.81	.331	.365	69.3	70.0	- 1.81	.586	.644	71.8	72.4
OFF	-.197	.375	.417	69.5	69.9	-.242 to -.248	.256	.310	68.8	69.0	-.153 to -.158	.532	.583	71.2	71.6

Figures 7-1 through 7-3 show typical discriminator strip charts of the excited ozone spectrometer experiment. This includes all telemetry channels except zero.

Figure 7-4 shows the outputs of the ozone broadband experiment recovered from telemetry playback using fixed input voltage levels.

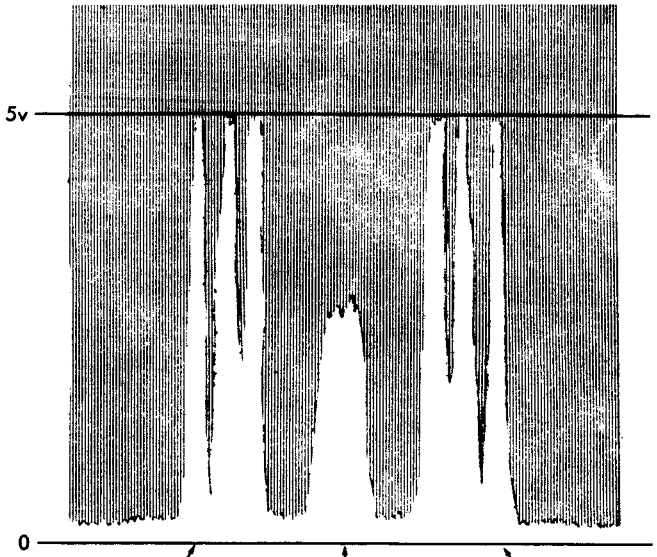


Figure 7-1—Discriminator Strip Chart of Excited Ozone Experiment Spectrometers at -5°C

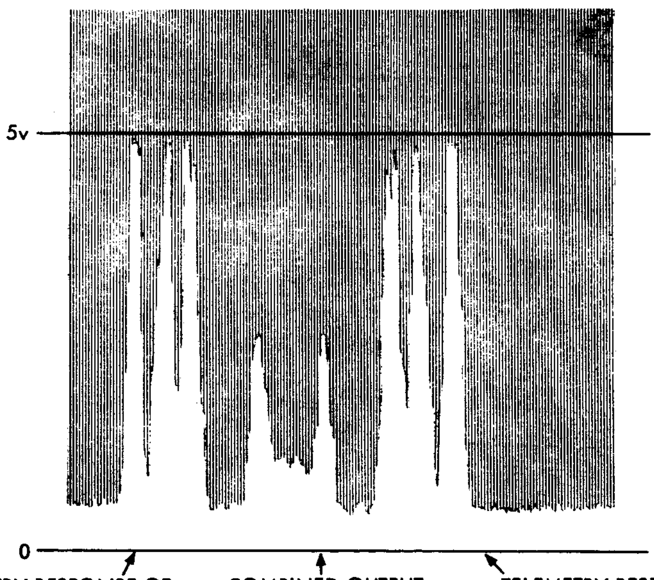


Figure 7-2—Discriminator Strip Chart of Excited Ozone Experiment at +25° C

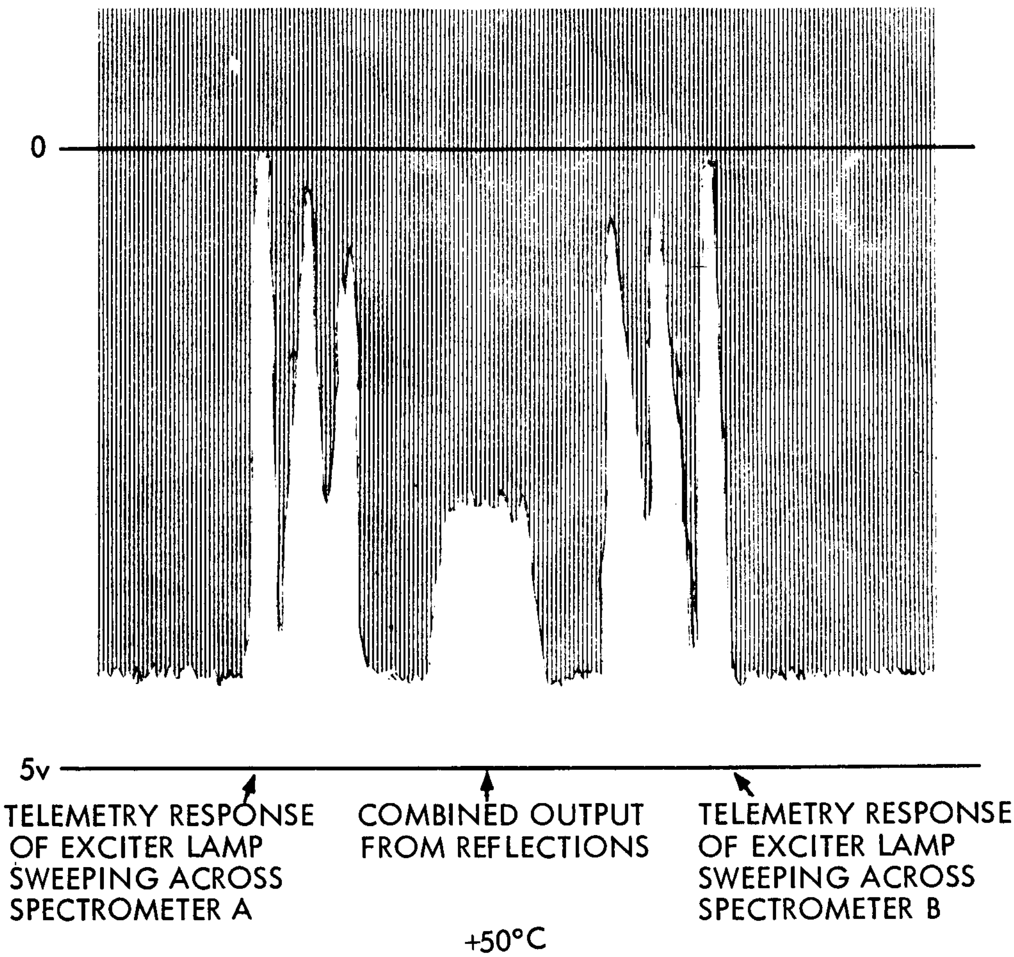


Figure 7-3—Discriminator Strip Chart of Excited Ozone Experiment Spectrometers at +50° C

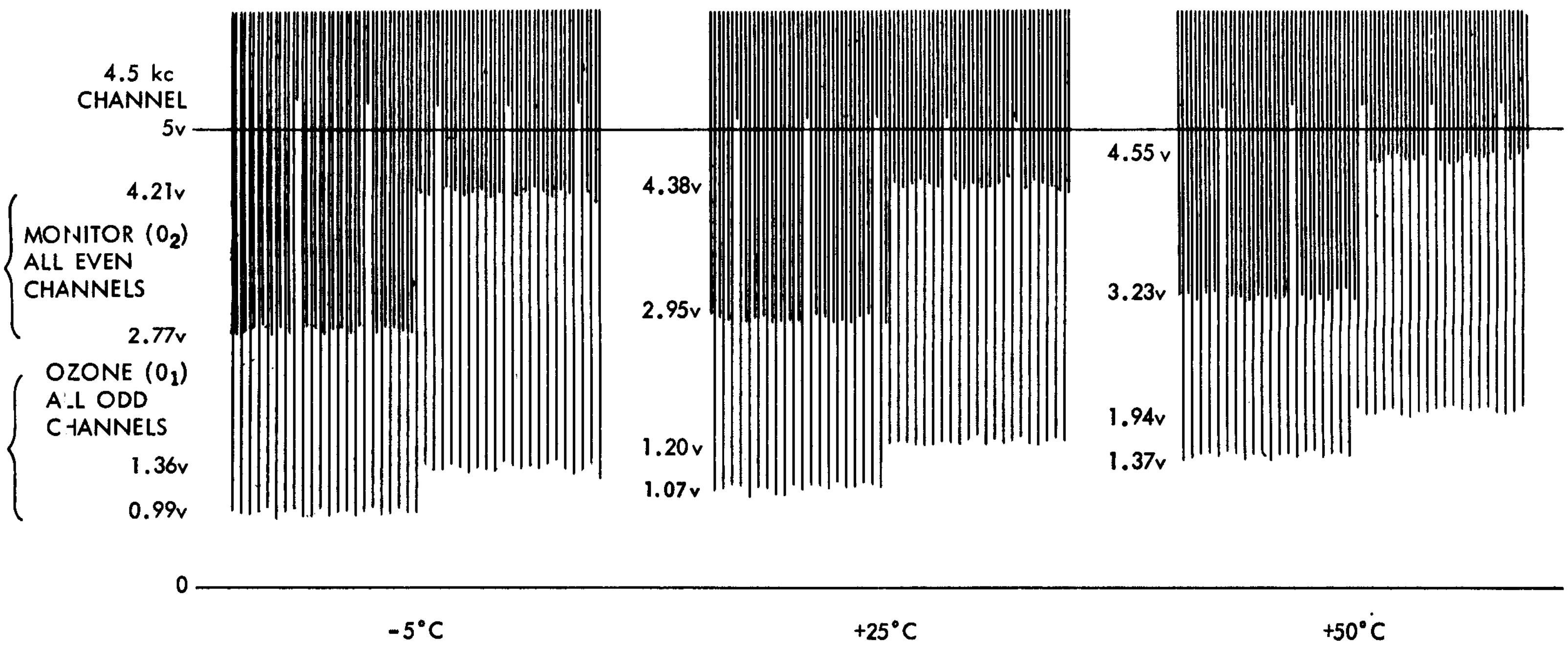


Figure 7-4—Discriminator Strip Charts of Excited Ozone Broadband (Low Speed) Experiments at -5°C, +25°C, and +50° C

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